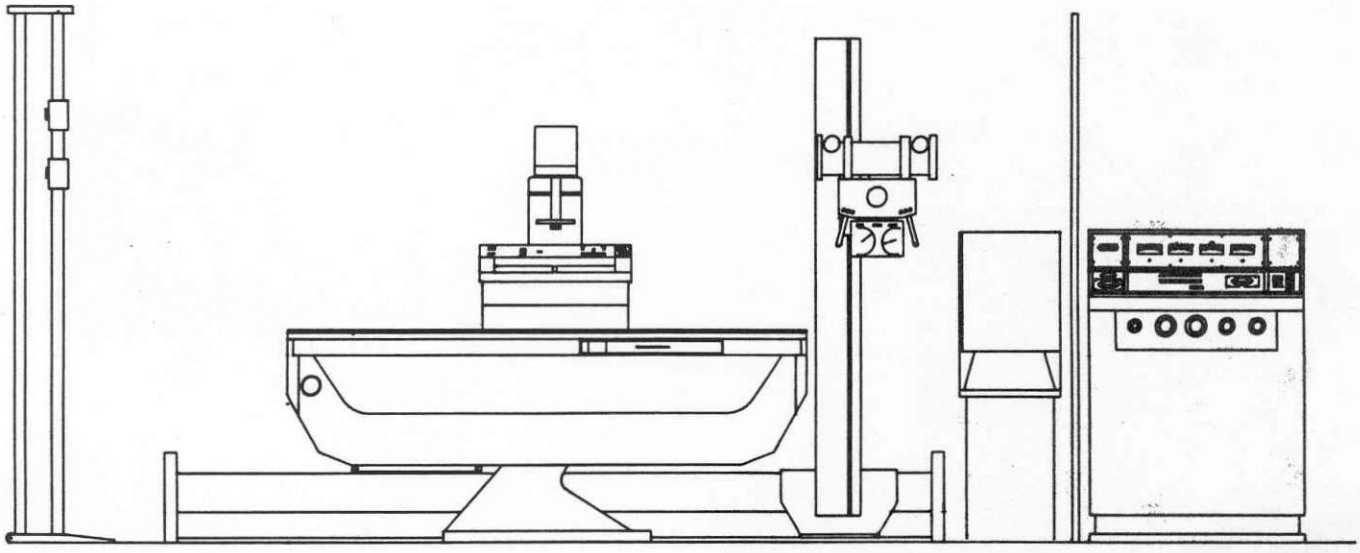
CS-8952 FIELD DEPLOYABLE X-RAY SYSTEM

OPERATOR'S MANUAL 9023.401



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SYSTEM OPERATOR'S MANUAL

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SECTION 1 - INTRODUCTION

1.1 GENERAL

This text provides the operator with a system overview, and describes the purpose and function of the operating controls and indicators.

The CS-8952 Field Deployable Radiographic/Fluoroscopic X-ray System utilizes two x-ray tubes to provide radiographic, image intensified fluoroscopic, and spot film capabilities. The x-ray system is capable of long time exposures of 5 mA at 150 kVp and momentary exposures of 300 mA at 150 kVp.

The system consists of the MXR-350 X-ray Generator, MXT-90/15 X-ray Table and Under-Table Collimator, CTC Tubestand and Over-Table Collimator, EXT-950 Spot Film Device, I-7802 6-Inch Image Intensifier with Mirror Viewer, Radiation Shield, and a Mobile Cassette Holder. The under-table x-ray tube has focal spots of 0.6 and 1.2, 12° target angle and 0° arm angle. The over-table x-ray tube has focal spots of 1.0 and 2.0, a 16° target angle and a 90° arm angle. Also included are Box A and Box B breaker panels for in coming power. The major system components are illustrated in FIGURE 1-1. The components are designed for three (3) installation configurations; in a hard wall shelter (FIGURE 1-2), a typical hospital environment (FIGURE 1-3), and in field expedient surroundings.

1.2 SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES

One of the most important considerations in x-ray work is protection against the hazards of x-ray radiation. The x-ray equipment itself does not pose any danger but careless and improper usage does. It is essential that all operator and service personnel be properly informed on this matter. Those responsible for the operation of this x-ray equipment must fully understand the dangers, be familiar with the characteristics of x-ray radiation, and become thoroughly acquainted with the instructions in this manual.

The following guidelines have been laid down for personal safety:

1. Never expose a human for demonstration purposes only.

2. Never remain in a radiographic room while an exposure is in progress. Approximately 0.1% of the useful beam is scattered perpendicular to the beam at a distance of 1 meter from the patient.

3. Patients should rarely be restrained for radiography. Many efficient devices are available to achieve the required results, in addition to the technologists ingenuity.

1.2 SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES (continued)

4. If a patient must be held, it should be done by a person not habitually exposed to ionizing radiation, whenever possible. In any case, this person must be protected by a lead apron and lead gloves.

5. Use an appropriate personnel film badge monitoring service and insist that all personnel are assigned a film badge, and wear them correctly.

6. During fluoroscopy, wear a protective apron, and when not actually assisting, stand in the control booth or behind the radiologist.

7. Periodically check protective aprons and gloves for cracks by a radiographic test using intensifying screens and exposure factors of 100 kVp, 10 mAs at a 100 cm (40-inch) focus-to-film distance.

1.3 MAXIMUM PERMISSIBLE DOSE

Many studies of the effects of x-ray radiation have been done to determine a "Maximum Permissible Dose". Conclusive evidence of what is a safe amount of radiation has remained elusive.

A safe rule to follow is "As Low As Reasonably Achievable" (ALARA). Always take all reasonable precautions to reduce radiation exposure as much as possible to patients, physicians, technicians, etc. at all times.

1.4 CDRH COMPLIANCE

All components of the x-ray system conform to the applicable requirements of the Center for Devices and Radiological Health (CDRH), Department of Health and Human Services, 21 CFR, Chapter 1, Subchapter J, at the time of manufacture.

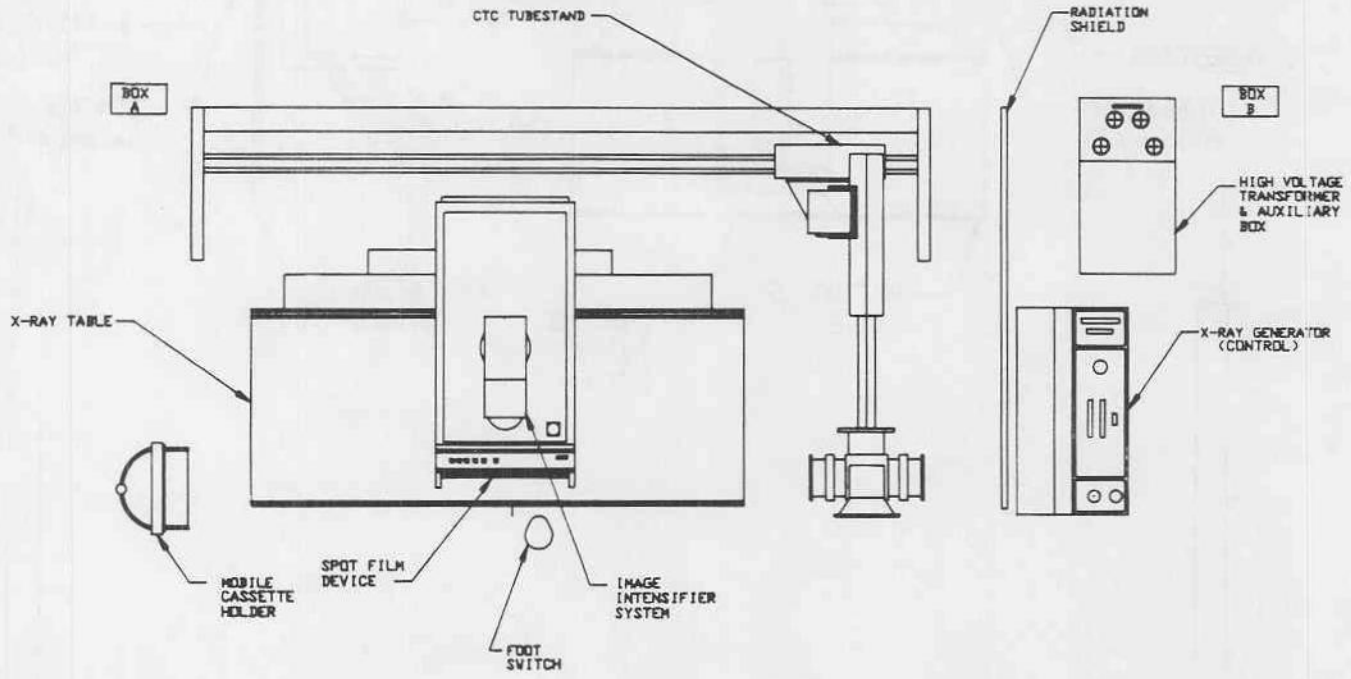


FIGURE 1-1 CS-8952 X-RAY SYSTEM

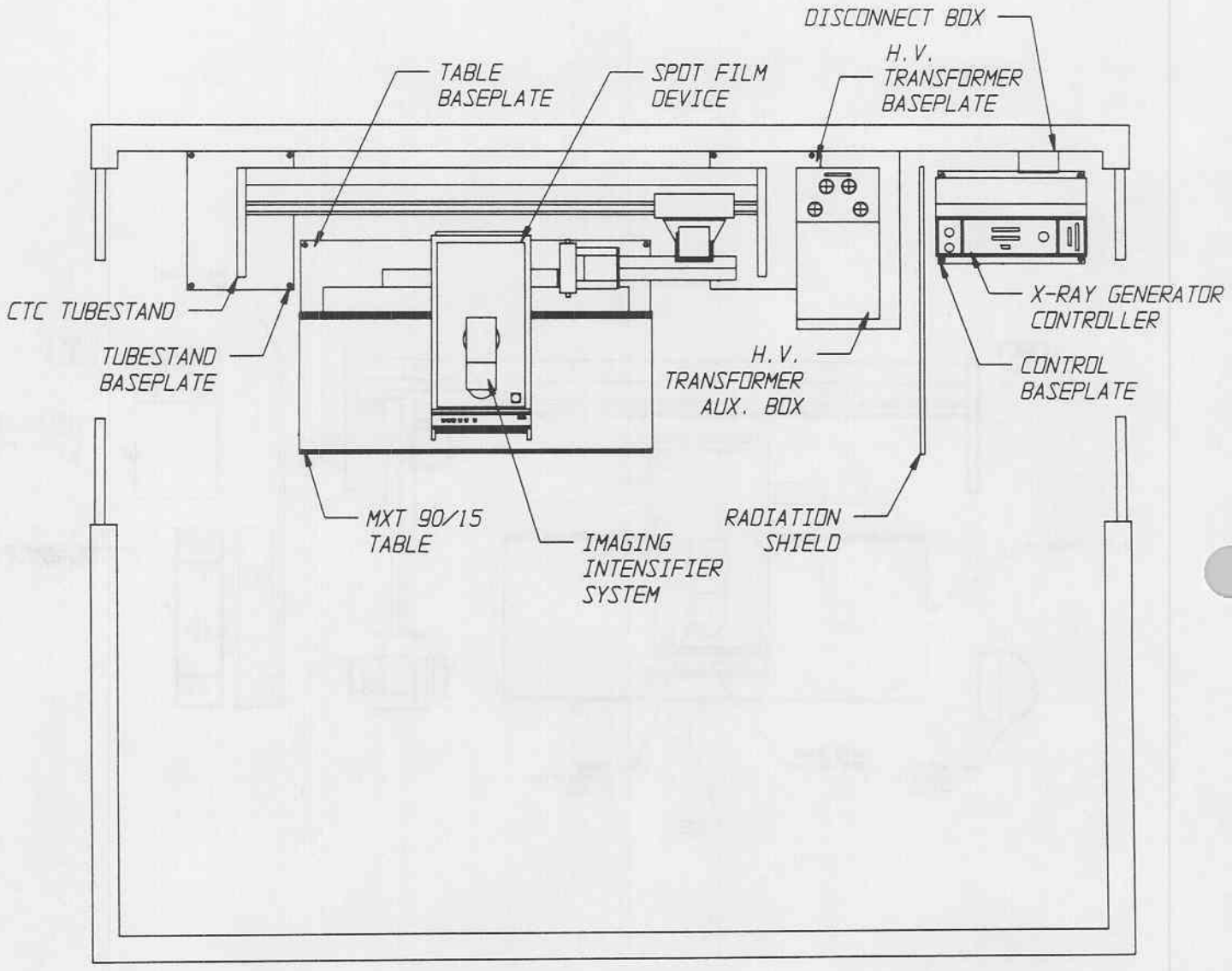


FIGURE 1-2 HARD WALL SHELTER CONFIGURATION

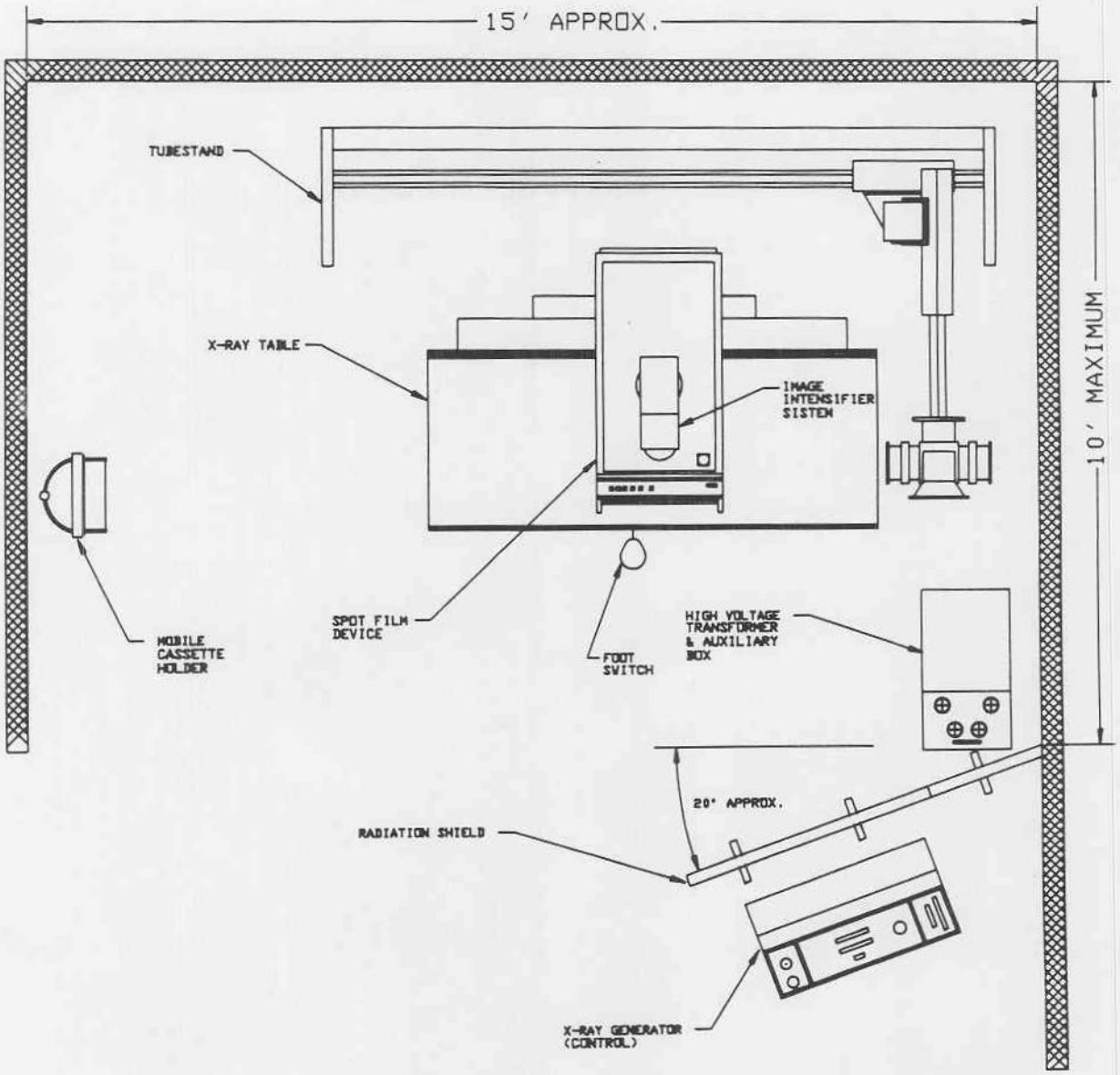


FIGURE 1-3 A TYPICAL HOSPITAL CONFIGURATION

SECTION 2 - CONTROLS AND INDICATORS

2.1 INTRODUCTION

This section describes the operating controls and indicators of each system component.

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (FIGURE 2-1)

All MXR-350 operator controls are located on the front of the main control. Most of these controls are located on the main panel and are grouped according to function. The remaining controls are located directly below the main panel on the front of the unit.

The meter panel is located directly above the main panel on the front of the main control. The meters on this panel enable the operator to monitor the main control operating conditions and status.

Some of the main panel controls are rotary switches that provide the operator with several selections. Most of the controls on the main section of the front panel are push button switches. Some of them are alternate action push buttons while others must be pressed and held. They all light to indicate that the functions they control are active. On an alternate action push button, the second pressing deactivates its function and extinguishes its light.

2.2.1 FLUOROSCOPIC CONTROLS - Fluoroscopy is frequently initiated from a remote table footswitch. The factors governing the exposure are set at the generator front panel by means of two (2) controls:

MILLIAMPERES - (A in FIGURE 2-1) The milliamperes control enables the operator to select any one of five (5) tube current values (A, B, C, D, E) during fluoroscopy. The preselected values depend on the radiation output of the x-ray tube and are between 0.5 and 5 milliamperes.

MINUTES - (B in FIGURE 2-1) Limits the length of the fluoroscopic exposure. This control allows the operator to make multiple fluoroscopic exposures of up to five (5) minutes total duration.

This control must be manually reset.

2.2.2 RADIOGRAPHIC (X-RAY) CONTROLS

MAINS - (C in FIGURE 2-1) Pressing the MAINS push button switch applies power to the generator. Pressing it a second time turns power off.

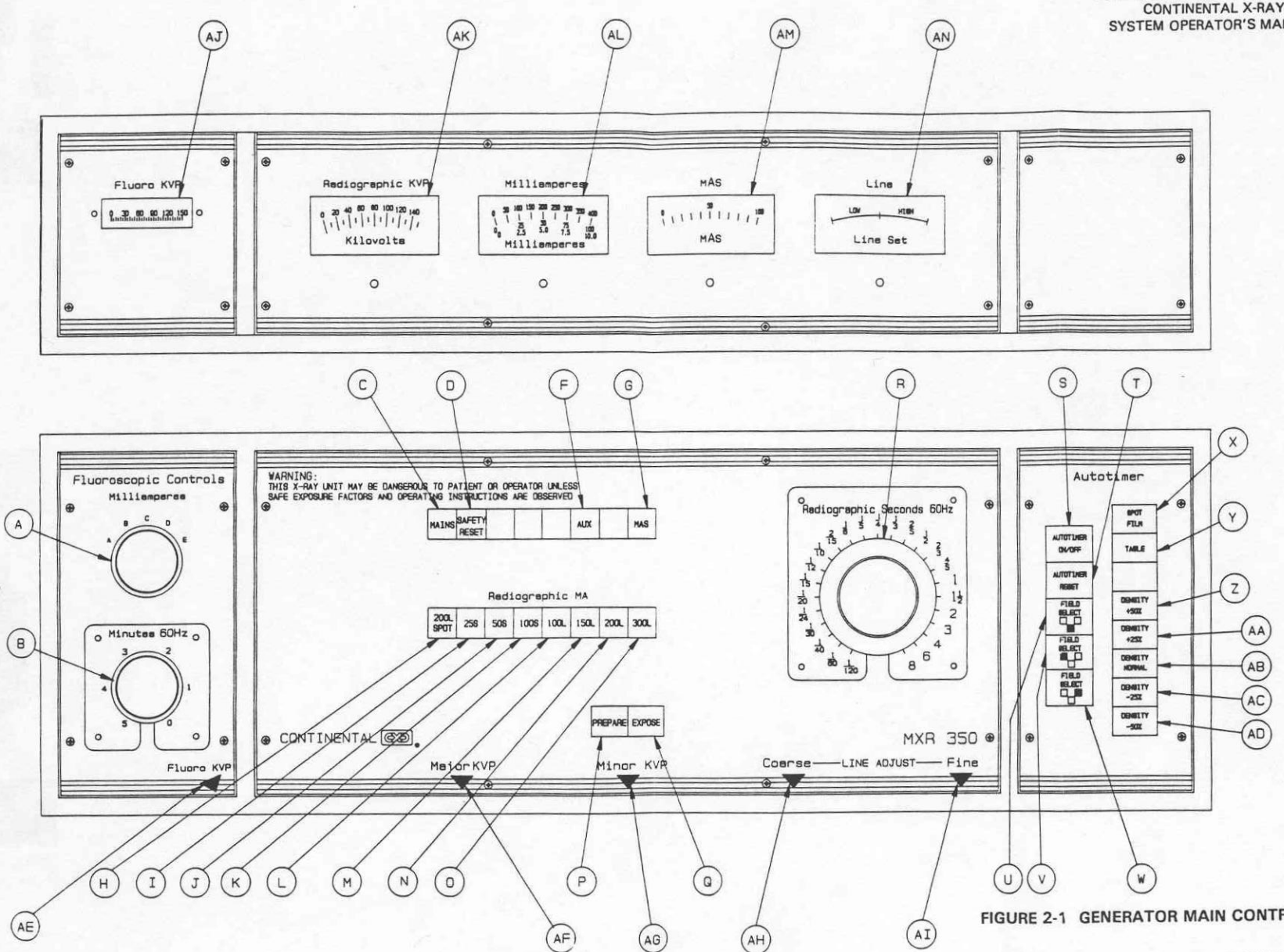


FIGURE 2-1 GENERATOR MAIN CONTROL PANEL

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (continued)

SAFETY RESET - (D in FIGURE 2-1) Serves as both an indicator and a control. As an indicator, it lights to indicate that the generator is disabled because a technique that would damage the x-ray tube in use has been selected or that a generator fault has occurred.

When the SAFETY RESET light illuminates, it prevents further radiographic exposures. If an improper technique has been selected, selecting a proper one will extinguish the SAFETY RESET light. If the SAFETY RESET light was energized during a previous exposure due to a fault condition (excessive mA, gassy x-ray tube, or transformer failure), the SAFETY RESET can be cleared by depressing the switch.

The operator should be aware that the radiograph being taken when the fault occurred will probably be under-exposed due to early termination by the fault condition. If the SAFETY RESET repeatedly illuminates because of a fault condition, service is required to diagnose and correct the specific cause of the fault.

To the right of the SAFETY RESET button are three (3) blank, unused buttons.

The next button, F in FIGURE 2-1, is marked AUX. This button is unused at this time. To the right of this button is one (1) additional blank button, also unused at this time.

MAS - (G in FIGURE 2-1) Pressing and holding the MAS push button, connects the mAs meter (AM in FIGURE 2-1) into the generator circuitry. This enables the meter to display the true mAs value for the selected exposure factors. Releasing the push button disables the mAs meter. mAs meter will continue to read as long as the mAs push button is depressed.

RADIOGRAPHIC MA - (H through O in FIGURE 2-1) The radiographic mA group of switches selects tube current and focal spot size. Except for 200L SPOT (H in FIGURE 2-1), all switches select the over-table tube, currents, and focal spots.

Depressing the 200L SPOT push button selects 200 mA on the large focal spot of the under-table x-ray tube for spot film techniques. This switch also disables the PREPARE and EXPOSE switches (P and Q in FIGURE 2-1) so their functions can be activated from the spot film device control panel or the table footswitch.

Switches I, J and K in FIGURE 2-1 select 25 mA, 50 mA, or 100 mA, respectively, on the small focal spot of the over-table tube. Switches L, M, N and O in FIGURE 2-1 select 100 mA, 150 mA, 200 mA, or 300 mA on the large focal spot of the same x-ray tube.

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (continued)

PREPARE AND EXPOSE - (P and Q in FIGURE 2-1) The PREPARE switch prepares the over-table x-ray tube for making exposures by ensuring the tube rotor is up to speed and the filament voltage is at the proper level for the mA selected. This switch performs its function only while it is pressed.

PREPARE does not initiate radiographic exposures; it is used with the EXPOSE switch to make the exposure. PREPARE and EXPOSE must both be pressed and held together to make an exposure.

EXPOSE and PREPARE are disabled when the 200L SPOT switch (H in FIGURE 2-1) is pressed. This allows their functions to be actuated from the spot film device control panel or the table footswitch.

RADIOGRAPHIC SECONDS - (R in FIGURE 2-1) Radiographic (x-ray) exposure timing is determined by the setting of the radiographic seconds control. The generator uses the AC power frequency as the time base for producing the interval selected by this control.

Since the generator can operate from either 50 Hz or 60 Hz, different exposure intervals are available with each of these frequencies. A two-sided nameplate is supplied for this control. One side of this plate identifies the exposure intervals for 60 Hz, the other specifies them for 50 Hz.

RADIOGRAPHIC SECONDS - (60 HZ) When the generator is powered from a 60 Hz line, the control allows the operator to select exposure intervals of 1/120, 1/60, 1/40, 1/30, 1/24, 1/20, 1/15, 1/12, 1/10, 2/15, 1/6, 1/5, 1/4, 1/3, 2/5, 1/2, 2/3, 4/5, 1, 1-1/2, 2, 3, 4, 6, and 8 seconds.

RADIOGRAPHIC SECONDS - (50 HZ) A 50 Hz power line enables the operator to use the control to select 1/100, 1/50, 3/100, 1/25, 1/20, 3/50, 2/25, 1/10, 3/25, 3/20, 1/5, 1/4, 3/10, 2/5, 1/2, 3/5, 4/5, 1, 1-1/2, 2, 3, 4, 5, 6, and 8 seconds.

AUTOTIMER - The AUTOTIMER provides an appropriate exposure duration for many x-ray techniques. This will optimize the finished radiograph while minimizing the patient's radiation dose. The autotimer density controls enable the operator to further enhance the quality of the exposure.

AUTOTIMER ON/OFF - (S in FIGURE 2-1) Pressing the AUTOTIMER ON/OFF switch enables the autotiming function. Autotiming is disabled when the switch is pressed a second time.

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (continued)

AUTOTIMER RESET - (T in FIGURE 2-1) If an autotimed radiograph is terminated by the back-up timer instead of by the autotimer, the AUTOTIMER RESET button will light. Pressing the AUTOTIMER RESET button will reset the autotimer circuitry, while alerting the operator to a possible problem with the radiograph.

FIELD SELECT SWITCHES - (U, V and W in FIGURE 2-1) The autotimer can be controlled by any combination of the three fields in the table's ion chamber. Field select switches in conjunction with the TABLE push button (Y in FIGURE 2-1) enable the operator to select the desired active ion chamber fields.

SPOT FILM - (X in FIGURE 2-1) The x-ray system is equipped with a spot film device, which has its own ion chamber. Pressing the SPOT FILM control activates this ion chamber while deactivating all others. Since the spot film chamber has only one field, the field select switches have no effect when this chamber is selected.

TABLE - (Y in FIGURE 2-1) This push button activates the table's three-field ion chamber. It must be pressed before the field select switches (U, V and W in FIGURE 2-1) can select the active field(s) in the ion chamber.

DENSITY - (Z, AA, AB, AC and AD in FIGURE 2-1) These five (5) push buttons control film density (contrast). Exposures are ordinarily made with DENSITY NORMAL (AB in FIGURE 2-1). Exposures can be darkened by pressing DENSITY +25% (AA in FIGURE 2-1) or DENSITY +50% (Z in FIGURE 2-1) as required, with DENSITY +50% being darkest. Pressing DENSITY -25% (AC in FIGURE 2-1) lightens the exposure and DENSITY -50% (AD in FIGURE 2-1) lightens it further.

KVP AND LINE ADJUST CONTROLS - (AE, AF, AG, AH and AI) The kVp and line adjust controls are large knobs located below the main control front panel, on the front of the unit. These five (5) rotary knobs are easily accessible through an opening in the front of the cabinet and are used in conjunction with the fluoro kVp meter (AJ in FIGURE 2-1), radiographic kVp meter (AK in FIGURE 2-1), and line set meter (AN in FIGURE 2-1) above the main panel.

FLUORO KVP - (AE in FIGURE 2-1) The fluoro kVp is a continuously variable knob that allows for the selection of any kilovoltage between 50 kV and 125 kV when fluoroscopic exposures are being made.

MAJOR KVP (AF in FIGURE 2-1) and MINOR KVP (AG in FIGURE 2-1) Radiographic high voltage can be set to kilovoltages between 40 kVp and 150 kVp in 1 kVp steps by means of the major kVp and minor kVp knobs. Rotating the major kVp knob changes the kilovoltage in detent steps of approximately 10 kVp each. The minor kVp knob changes by approximately 1 kVp steps. These knobs must be positioned correctly on a discrete step.

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (continued)

COARSE LINE ADJUST (AH in FIGURE 2-1) and FINE LINE ADJUST (AI in FIGURE 2-1) Coarse line adjust and fine line adjust are used together to compensate for variations in the line voltage.

2.2.3 METERS - The front panel meters allow the operator to monitor generator operations. Several of these analog meters are used in conjunction with controls already discussed.

FLUORO KVP METER - (AJ in FIGURE 2-1) The fluoro kVp meter displays the x-ray tube kilovoltage in the fluoroscopic mode, as set by the fluoro kVp control (AE in FIGURE 2-1).

RADIOGRAPHIC KVP METER - (AK in FIGURE 2-1) This meter displays the radiographic x-ray tube kVp as selected by the settings of major kVp knob (AF in FIGURE 2-1) and the minor kVp knob (AG in FIGURE 2-1).

MILLIAMPERES METER - (AL in FIGURE 2-1) The milliamperes meter displays the amount of current being drawn by the x-ray tube during exposures; the meter is not operational at other times.

MAS METER - (AM in FIGURE 2-1) This meter displays the mathematical product of tube current and exposure length. To activate, press the MAS push button (G in FIGURE 2-1) during exposure. The mAs meter resets to zero when the MAS button is released.

LINE SET METER - (AN in FIGURE 2-1) The line set meter indicates when the applied (line) voltage is correctly adjusted. Instead of a numerical scale, a reference mark indicates the center of the meter. When the voltage applied to the generator is correct, the meter points to this mark.

If the voltage is lower than normal, the meter points to the low side of the scale. If the voltage is higher than normal, the meter deflects toward the high end.

Input voltage, and the resulting meter deflection of the line set meter, is adjustable by rotating the coarse (AH) and fine (AI) line adjust controls as needed to position the pointer at the center reference mark.

2.3 SPOT FILM DEVICE (FIGURE 2-2)

Most of the controls on the spot film device front panel are alternate action push button switches. Some are for the spot film device, while others control making x-ray exposures, the collimator mode setting, positioning the table top, and setting or releasing spot film device locks. These switches light to indicate when they are active.

In addition to the push button controls, the front panel also has two slide controls, a rotary control, and a two-position, spring-loaded, center-off rotary switch. The front panel has an LED display to provide a visual indication of the spot film format selected. The LED display indicates certain errors, such as the cassette carriage is empty, all exposures have been made (the cassette is "full"), or the spot film device is not properly locked into position.

A power assist handle is on the front of the unit. This assists movement of the spot film device in the longitudinal direction only.

COLLIMATOR AND MODES OF OPERATION

COLLIMATOR - The under-table collimator works in conjunction with the spot film device. The collimator enables automatic regulation of the size of the radiation field to preset limits, according to the format selected and the source-to-image distance (SID).

MODES OF OPERATION - The ability of the spot film device to control the under-table collimator is one of its most important characteristics. It exercises this control in three ways:

- automatic radiography (spot film)
- manual radiography (spot film)
- fluoroscopy.

The spot film device automatically sets the collimator shutters according to the format selected and its distance from the table when a spot film exposure is requested.

Control over the size of the collimator aperture is similar in the manual radiographic and fluoroscopic modes of operation. The operator has manual control over the collimator shutters by means of front-panel controls.

When taking spot films, aperture size cannot be increased beyond the preset frame size for the selected spot film format. When in fluoroscopy, the front panel controls allow the operator to vary the aperture from fully closed to fully opened, as determined by the size of the image intensifier.

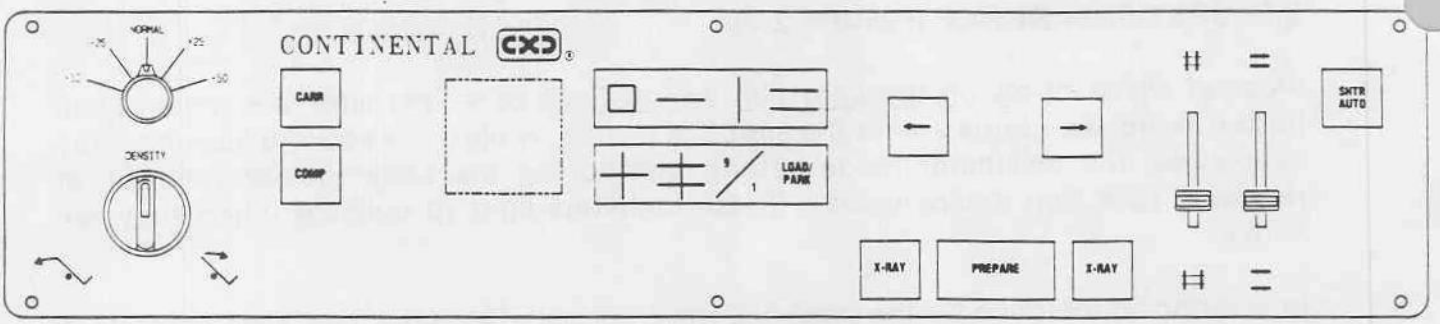


Figure 5.1

A — CARR — TRANSVERSE AND LONGITUDINAL LOCKS (PUSH ON, PUSH OFF)

B — COMP — COMPRESSION LOCK (PUSH ON, PUSH OFF)

C — DENSITY CONTROL

D — SHTR AUTO — SHUTTER AUTO

E — X-RAY — X-RAY REQUEST FLUORO OR RADIOGRAPHIC WHEN IN PREPARE

F — PREPARE — PREPARE REQUEST

G1 — 1 ON 1 FILM FORMAT

G2 — 2 ON 1 FILM FORMAT

G3 — 2 ON 1 FILM FORMAT

G4 — 3 ON 1 FILM FORMAT

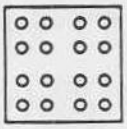
G5 — 4 ON 1 FILM FORMAT

G6 — 6 ON 1 FILM FORMAT

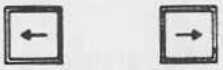
G7 — 9 ON 1 FILM FORMAT

G8 — CASSETTE LOAD/PARK

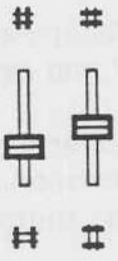
TABLE TILT CONTROL
H



FORMAT INDICATION (4 ON 1 FORMAT SHOWN)
I



TWO WAY TABLE TOP CONTROL
J



LONGITUDINAL MANUAL COLLIMATOR CONTROL
K

TRANSVERSE MANUAL COLLIMATOR CONTROL
L

FIGURE 2-2 SPOT FILM FRONT CONTROL PANEL

2.3 SPOT FILM DEVICE (continued)

CARR LOCKS - (Carriage Locks - A in FIGURE 2-2) Actuates the Carriage Locks. When switch A is pressed, its illumination increases to indicate that the transverse and longitudinal locks are engaged. Pressing it a second time decreases its light level while releasing the locks so the spot film device can be repositioned.

COMP LOCKS - (Compression Lock - B in FIGURE 2-2) When active, this lock prevents movement of the spot film device toward or away from the table. Pressing this switch engages the compression lock, and increases the light level of the switch. Pressing it again releases the lock, allowing the spot film device to be repositioned.

DENSITY - (C in FIGURE 2-2) This is a rotary control for setting the density of spot film exposures. Rotating this control to the right increases density. Rotating it to the left decreases it.

LED DISPLAY - (I in FIGURE 2-2, and FIGURE 2-3) The spot film device LEDs provide a visual representation of the spot film format selected. The display consists of 25 LEDs arranged in a five by five grid which light to form a pattern. The LEDs representing each frame in the selected format go out as the frame is exposed.

ERROR CODES - FIGURE 2-3 When the display looks like the letter "C", it indicates there is no cassette in the carriage, all exposures in the selected format have been made, or the cassette holder is empty in its forward position.

When the display looks like the letter "X", it indicates the spot film device is not locked in its forward position.

FORMAT SELECTION SWITCHES (G1-G7 in FIGURE 2-2) - The spot film device can make as many as nine (9) exposures on a film cassette using any one of seven (7) formats that can be selected before beginning an exposure sequence.

Double exposures are prevented by microprocessor controlled logic, and cassettes can be ejected at any time during the exposure sequence. This logic circuitry also automatically controls aperture size when the SHTR AUTO push button (D in FIGURE 2-2) is lit.

2.3 SPOT FILM DEVICE (continued)

- push button G1 selects the One-On-One Spot Film format
- push button G2 selects Two-On-One Longitudinal (head-foot)
- push button G3 selects Two-On-One Transverse (front-back)
- push button G4 selects Three-On-One
- push button G5 selects Four-On-One
- push button G6 selects Six-On-One
- push button G7 selects Nine-On-One

The light in each of these switches brightens when that format is selected.

PARK/LOAD - (G8 in FIGURE 2-2) Pressing switch "G8" causes the spot film device to load and park a cassette.

WARNING

NEVER INSERT A CASSETTE INTO THE FRONT PANEL SLOT BEFORE DETERMINING LOCATION OF CASSETTE TRAY.

The tray must be in the forward (load) position before a cassette is inserted. The operator should visually inspect the spot film device to ascertain the position of the cassette tray. After the exposures have been made and the cassette is parked, pressing this button again moves the cassette forward and out for ejection.

TABLE TOP MOTION CONTROLS - (J in FIGURE 2-2) These two momentary push button switches control table top longitudinal movement. As the arrows indicate, the switches of "J" move the table top toward the head end and toward the foot.

MANUAL COLLIMATOR CONTROLS AND AUTOMATIC COLLIMATION - (K, L, AND D in FIGURE 2-2) When the spot film device is in the radiographic (spot film) mode and the SHTR AUTO (automatic/manual) push button (D in FIGURE 2-2) has been pressed, "auto mode", automatically determines the collimator aperture size for all spot film formats.

Pressing SHTR AUTO a second time sets the spot film device to the manual mode. In this mode, the operator has control over the collimator aperture size with the use of controls "K" and "L" in FIGURE 2-2. Slide control "K" varies the opening of the head-foot (longitudinal) shutter blades and slide control "L" varies the opening of the front-back (transverse) blades. Both controls can be used together for simultaneous movement of the shutter blades. At no time can the shutter blades be open beyond the frame size of the selected format.

2.3 SPOT FILM DEVICE (continued)

Slide controls always operate the collimator aperture when the spot film device is in the fluoro mode of operation. When the system is in the radiographic mode, the collimator aperture cannot be increased beyond the frame size for the selected format. To close the shutters, slide the controls up; sliding the controls down opens them.

PREPARE AND X-RAY - (F AND E in FIGURE 2-2) Pressing the PREPARE switch causes the cassette to move from the rear (park/fluoro position) into position for the next unexposed frame in the selected format. Releasing the switch without also pressing X-RAY allows the cassette to return to the park/fluoro position without exposing the film or advancing the frame.

PREPARE must be pressed and held while making exposures.

PREPARE ensures that the x-ray tube rotor is up to speed, the filament voltage is at the proper level, unlocked locks are engaged, etc.

The PREPARE switch and one of the X-RAY switches (E in FIGURE 2-2) must be simultaneously pressed and held once for each exposure.

If it is necessary to interrupt a spot film sequence, the spot film device "knows" its location on a given cassette during any spot film sequence. It avoids double exposures by resuming with the next open frame after an interruption, provided that the cassette has not been ejected.

Pressing either X-RAY switch or the footswitch without pressing PREPARE, initiates a fluoroscopic exposure that continues until the initiating switch is released or the fluoro time expires.

TABLE TILTING - (H in FIGURE 2-2) Table tilting is under the control of the spring-loaded, two-position, center-off rotary switch at the lower left of the front panel. Rotating and holding this switch to the right causes the table to tilt to the right. When the switch is released, it returns to its center-off position and table movement stops.

Rotating the switch to the left causes the table to tilt to the left. Releasing the switch allows it to return to its center-off position and table movement stops.

This switch only activates the table tilting mechanism.

It does not affect the table's tilt speed or its maximum vertical or Trendelenburg positions. These are determined by its mechanism.

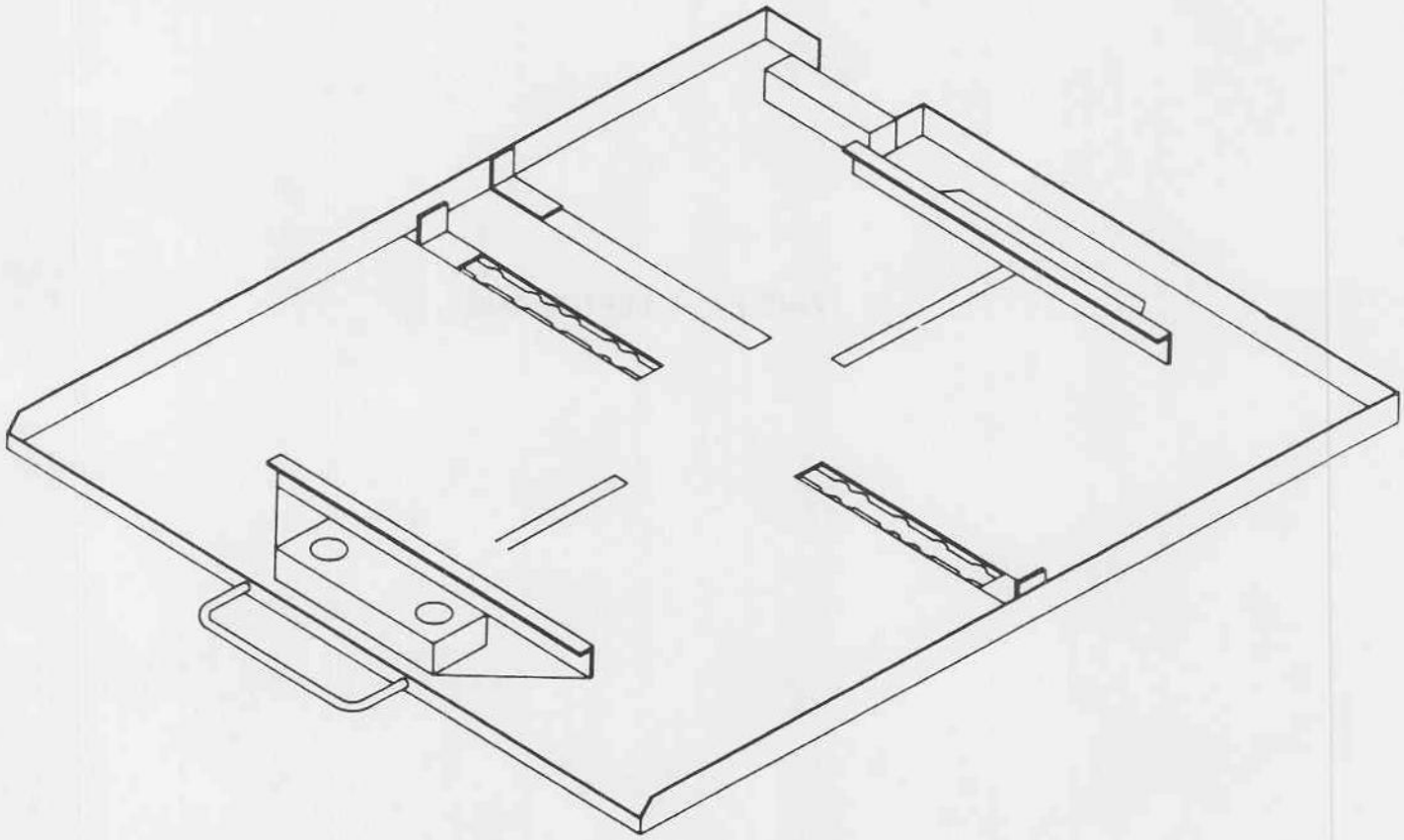


FIGURE 2-16 CASSETTE SENSING TRAY

2.3 SPOT FILM DEVICE (continued)

SPOT FILM DEVICE POSITIONING - The table mounted spot film device carriage enables the operator to position the spot film device at any location over the patient in three (3) dimensions. The under-table x-ray tube and collimator are mechanically linked to the spot film device, both laterally and longitudinally, and will move along with the spot film device.

POWER ASSIST HANDLE - The power assist handle, located on the front of the spot film device, assists in longitudinal repositioning of the spot film device, under-table x-ray tube, and collimator. It also automatically disengages the longitudinal and transverse locks, if they are engaged, during spot film device movement.

A small amount of lateral pressure on the handle toward the left disengages the locks, if they are engaged (push button A in FIGURE 2-2 is brightly lit) and activates the Power Assist circuit. This moves the spot film device, tube and collimator toward the head end of the table until pressure is released.

If the locks are engaged, releasing the pressure stops carriage motion and re-engages them. If push button "A" is dimly lit (locks are not engaged), the spot film device carriage motion stops without re-engaging the locks.

Operation is similar for repositioning toward the foot end of the table when handle pressure is exerted to the right.

WARNING

THE VERTICAL (COMPRESSION) CARRIAGE ALLOWS THE CONE AND SPOT FILM DEVICE CHASSIS TO COME IN CONTACT WITH PATIENTS, AS IS NECESSARY FOR SOME PROCEDURES. IN OTHER PROCEDURES, SUCH AS MYELOGRAMS, CONTACT CAN BE DANGEROUS AND RESULT IN SERIOUS PATIENT INJURY.

IT IS VITAL THAT THE MYELOGRAPHIC STOP BE SET ON THE SPOT FILM DEVICE TOWER TO PREVENT THE SPOT FILM DEVICE AND/OR CONE FROM CONTACTING THE PATIENT WHEN THESE PROCEDURES ARE BEING PERFORMED.

2.3 SPOT FILM DEVICE (continued)

CASSETTE LOADING/UNLOADING - The spot film device accepts standard 9-1/2" X 9-1/2" (24 cm X 24 cm) cassettes through a slot directly below the power assist handle. Before loading in a new cassette, make certain the cassette receptacle is in its forward position.

WARNING

CASSETTE CAN "JAM" IF THE OPERATOR ATTEMPTS TO LOAD A CASSETTE WHEN THE CASSETTE RECEPTACLE IS NOT IN THE "LOAD" POSITION.

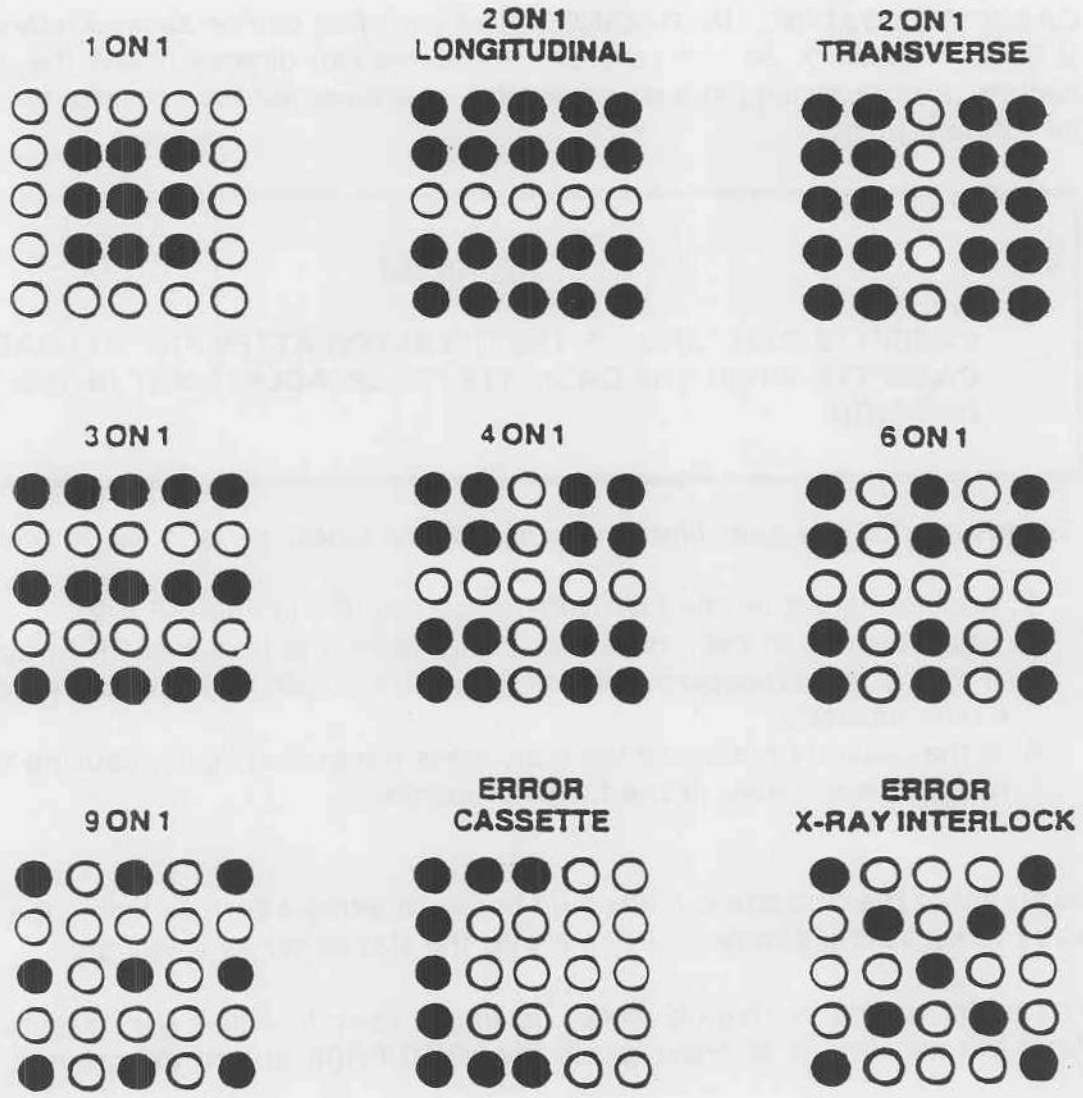
To ensure that the spot film device receptacle (carriage) is in the forward position:

1. position finger on the LOAD/PARK button (G8 in FIGURE 2-2)
2. while looking in the cassette opening, press the LOAD/PARK button
3. if the cassette receptacle moves forward, the spot film device is ready to accept a new cassette
4. if the cassette moved to the rear, press the button again, causing the cassette receptacle to move to the forward position.

Be sure that the cassette is face down (x-ray penetrable surface facing the under table x-ray tube) before gently inserting it into the slot as far as it will go.

The width of the carriage is fixed, making it easy to insert the cassette correctly. After the cassette is inserted, press the LOAD/PARK button to park it.

Unloading the cassette consists of momentarily pressing the LOAD/PARK button a second time. The carriage then moves the cassette forward and out, making it easy to remove the cassette.



O - INDICATES LED ON
. - INDICATES LED OFF

ERROR CASSETTE - There is no cassette or the cassette is full.

ERROR X-RAY INTERLOCK - The spot device is not locked in the forward expose position.

FIGURE 2-3 SPOT FILM DEVICE SELECTED DISPLAY

2.4 TABLE CONTROLS - (FIGURE 2-4)

TABLE FRONT PANEL CONTROLS:

The table front panel is located at the head end of the table skirt. The panel consists of five (5) illuminated, single-action (press and hold) push button switches. Each switch lights to indicate that the motion it controls is active. Pressing any given switch initiates motion that continues until maximum placement is reached or the switch is released, whichever occurs first. The motions controlled by the switches are as follows:

TABLE TOP HEAD CONTROL - (switch A in FIGURE 2-4) Activates the table top movement longitudinally toward the head end. Maximum center-to-head displacement is 30" (762 mm).

TABLE TOP FOOT CONTROL - (switch B in FIGURE 2-4) Activates movement of the table top toward the foot end of the table. Maximum longitudinal travel is 30" (762 mm) center to foot.

TABLE TOP CENTER CONTROL - (switch C in FIGURE 2-4) Activates and centers the top, regardless of its previous head or foot end position.

TRENDELENBURG TILT CONTROL - (switch D in FIGURE 2-4) The table tilts toward a maximum Trendelenburg position of 12° at a rate of 4° per second when the push button is depressed.

VERTICAL TILT CONTROL - (switch E in FIGURE 2-4) When depressed, the table tilts toward the foot end up to a maximum of 88° at 4° per second.

ANGULATION GAUGE - The gravity-operated angulation gauge is mounted on the table skirt at the head end of the table above the footstep. The gauge rotates as the table is tilted. A slot in the table skirt at the top of the angulation gauge points to the angle of the table.

MYELOGRAPHIC STOP - A myelographic stop to limit the travel of the vertical carriage is located at the rear of the table on the table tower. To use this mechanical device, rock it upward and slide it to the desired position. It automatically locks when it is released.

TABLE FOOTSWITCH - The table has a two-stage footswitch for use with fluoroscopy and spot filming in conjunction with the spot film device. During fluoroscopy only, pressing hard on the footswitch activates the second stage, which raises the fluoro mA to the high level mode.

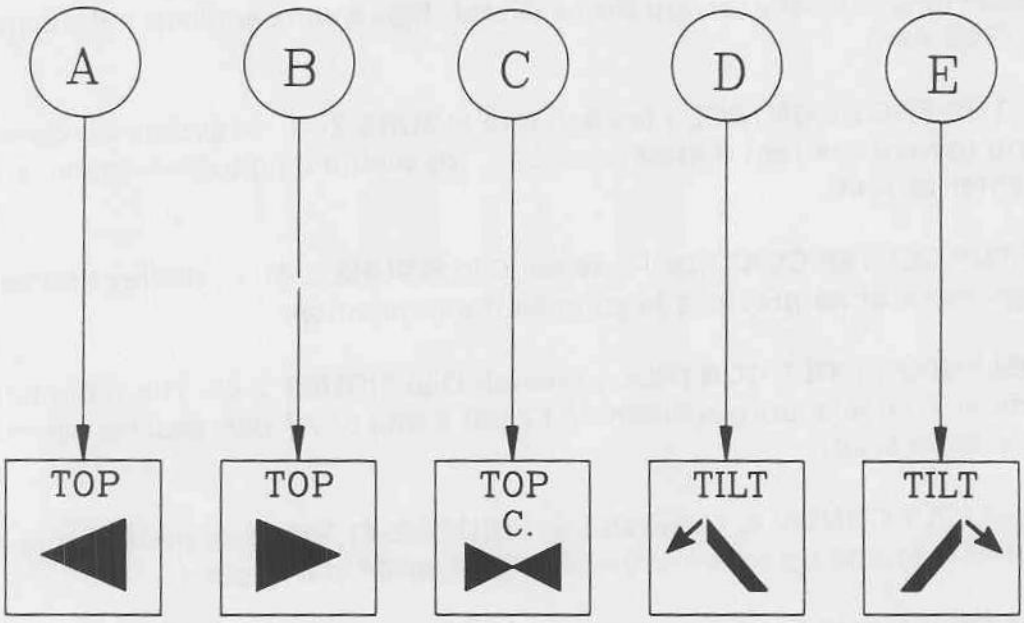


FIGURE 2-4 TABLE CONTROL PANEL

2.5 TUBESTAND AND RADIOGRAPHIC COLLIMATOR - (FIGURE 2-5)

The tubestand is equipped with four (4) electromagnetic locks and two (2) mechanical locks. The electromagnetic locks are controlled by six (6) switches on the control panel and are always engaged until they are released by depressing the appropriate switch.

The tubestand control panel has switches for electric locks that control the tubestand vertical, lateral, lateral centering, and roll motions.

ELECTROMECHANICAL LOCKS - The tubestand uses electromechanical locks for all of its motions.

ROLL LOCK - (ROLL in FIGURE 2-5) When the ROLL switch is pressed, the x-ray tube can be manually rolled to any angle between 90° toward the head or foot end of the table, for total range of 180°. Releasing this push button switch locks the x-ray tube at the desired angle.

LONGITUDINAL LOCK - (LONG in FIGURE 2-5) Longitudinal travel of the tubestand is controlled by the LONG switch. When this switch is pressed, the lock releases and allows travel of the tubestand along the floor rail.

LATERAL LOCKS - (LAT and LAT CTR in FIGURE 2-5) The LAT switch controls the lateral travel of the tube carriage. Depressing the LAT CTR (Lateral Center) switch allows the lateral lock to be automatically applied when the x-ray tube focal spot crosses lateral center line of the table top, but released at all other times. To release the tube when it is locked at the lateral center line, press the LAT switch.

ALL - (ALL in FIGURE 2-5) Pressing the ALL push button switch simultaneously releases all locks except ROLL.

VERTICAL LOCK - (VERT in FIGURE 2-5) The VERT switch controls the travel of the vertical carriage on the column. This switch allows the operator to set the x-ray tube at the desired height. The vertical height scale, on the vertical column, allows the operator to determine the distance of the focal spot from the table top and the table grid cabinet.

MECHANICAL LOCKS

PITCH - (LOCATED ON RIGHT SIDE OF TUBESTAND CONTROL PANEL) Loosening the pitch lever allows manual transverse tilting of the tube head between 30° toward the table front and 20° toward the rear. Tightening the lever locks the head in the desired position.

2.5 TUBESTAND AND RADIOGRAPHIC COLLIMATOR (continued)

VERTICAL COLUMN ROTATION - The tubestand vertical column is capable of manual rotation through 360°. Its base is equipped with four (4) detents to hold it into position at:

- 0°/360° x-ray tube head directly over the table
- 90° x-ray tube head toward the head end
- 180° x-ray tube head directly away from the table top
- 270° x-ray tube head toward the foot end.

The tubestand may be mounted so close to a wall that its motion is restricted. The vertical column rotation is ordinarily from the table's head end to the foot end for a usable range of 180°.

Manual rotation of the tubestand is accomplished by applying enough force to overcome the resistance of a detent (if one is engaged) and turning the vertical column to the desired position.

RADIOGRAPHIC COLLIMATOR (FIGURE 2-5) The collimator limits the x-ray beam to the film size. The bottom of the collimator has grooves to allow a "beam-limiting" cone to be attached. The collimator controls are:

LAMP ON/OFF - Press the push button to start the timed light display. The light goes out after approximately 30 seconds. The light beam is focused off an internal mirror.

LONGITUDINAL SHUTTER ADJUSTMENT - Controls the longitudinal shutters.

TRANSVERSE SHUTTER ADJUSTMENT - Controls the transverse shutters.

MIRROR RETRACTOR - Allows operator to move the light-beam mirror out of the way to allow visual inspection of the x-ray tube. The retractor switch is a small circular opening on the bottom of the collimator. Activate with a small screw driver.

WARNING

DO NOT LOOK DIRECTLY AT THE X-RAY TUBE WHILE ON!

2.5 TUBESTAND AND RADIOGRAPHIC COLLIMATOR (continued)

SOURCE-IMAGE DISTANCE (SID) SCALE - Sliding the knob positions the scale at detents of 40" or 72", indicating field coverage at these SID's.

SID INDICATORS - Indicating lamps that correspond to vertical and horizontal SID's.

EXPOSURE HOLD INDICATOR - Indicates the shutters are not properly positioned, vertical SID is not positioned at 40", or the horizontal SID is not positioned at standard SID's.

MANUAL INDICATOR - Indicates the collimator or table is tilted greater than 10° away from vertical or horizontal, cassette is not located in the cassette tray, or cassette tray is not fully inserted in the carrier.

READY INDICATOR - Indicates the shutters are properly positioned.

TAPE MEASURE - On the bottom of the right side of the collimator is a "pull-down" tape measure, to facilitate measuring SID.

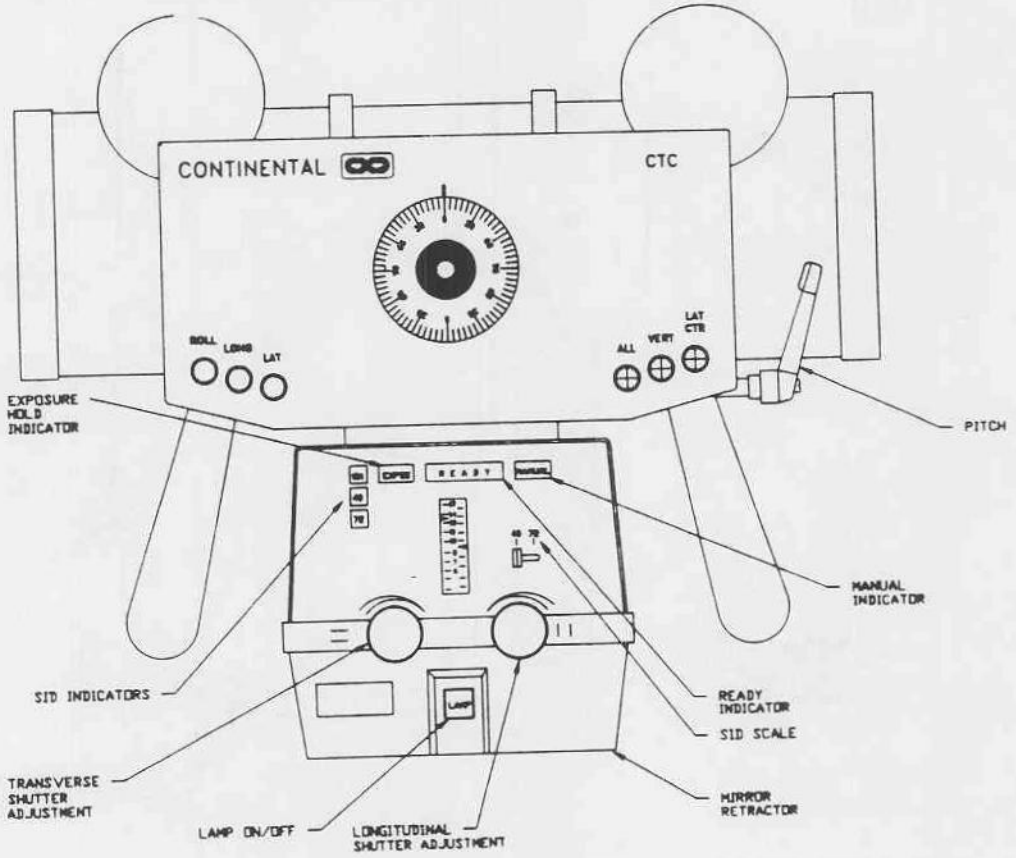


FIGURE 2-5 TUBESTAND AND COLLIMATOR CONTROLS

2.6 IMAGING SYSTEM - (FIGURE 2-6)

The fluoroscopic image is viewed by means of a mirror. Most of the system's operation is automatic, requiring a minimum of operator control. Angulation and height adjustments enable the user to position the mirror for comfort and optimum viewing.

To adjust the angle of the mirror, grasp it by the protruding edge and tilt it to the desired angle.

Mirror height is adjusted by using its bottom bracket to raise or lower it to the desired height. An adjustment screw with locking nut is installed on the rear of the height adjustment bracket for controlling the amount of force needed to reposition the mirror.

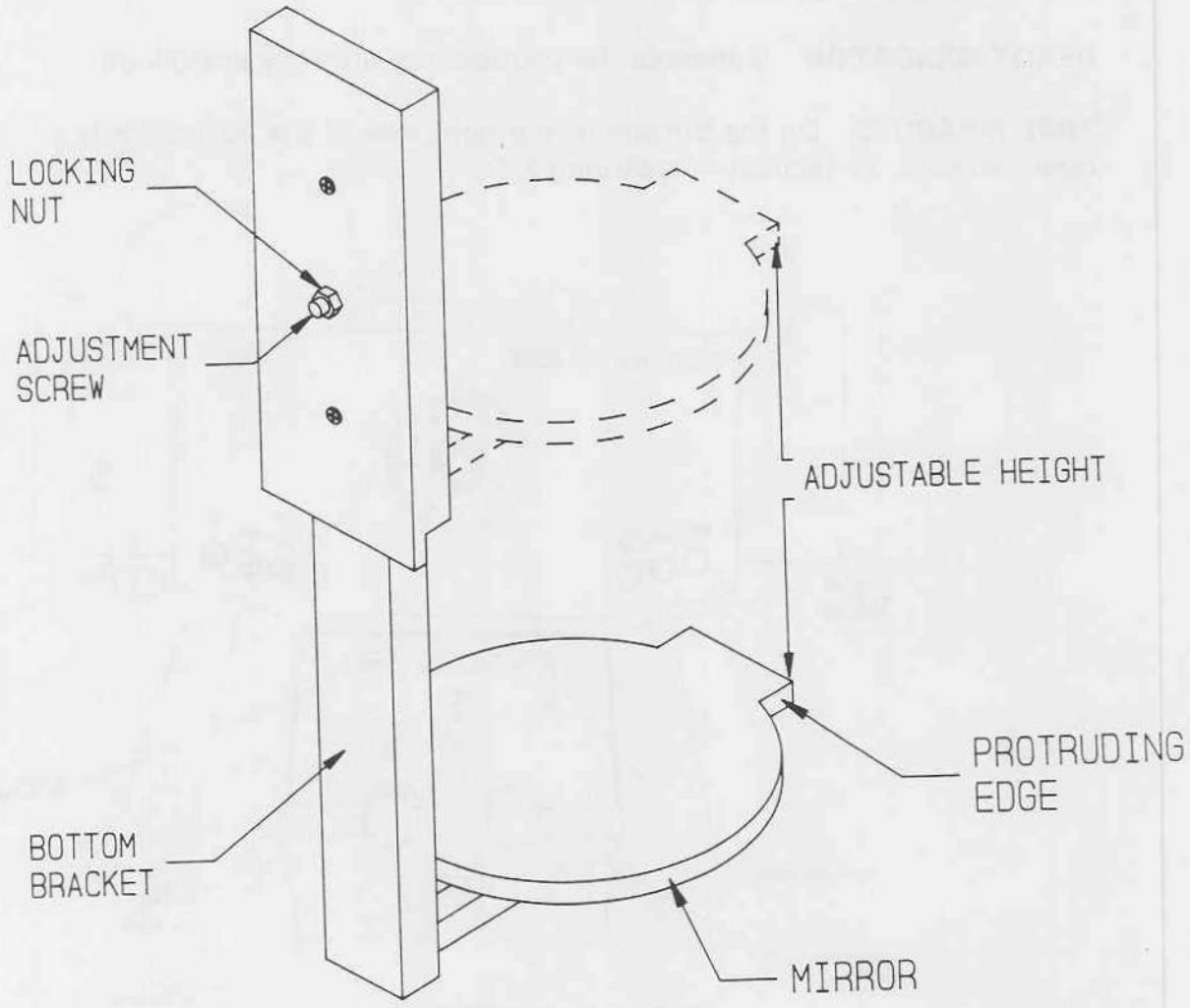


FIGURE 2-6 IMAGING SYSTEM

2.7 SYSTEM ACCESSORIES - (FIGURES 2-7 through 2-16)

A full complement of easily attachable and removable accessories is supplied with the MXT-90/15 Table. This section describes the placement and use of these accessories.

FOOT REST (FIGURE 2-7) - two (2) spring-loaded latches with hand grips hold the foot rest on the table. Squeezing the hand grips against the handles releases the latches so that the foot rest can be attached on or removed from the table top. To attach the foot rest:

1. Stand at the foot of the table and hold the foot rest by the hand grips.

2. Squeeze both hand grips against the handles while sliding the foot rest onto the foot end of the table top.

3. Position the foot rest over the desired notch pairs in the table top edges and release the hand grips.

4. Be certain that the foot rest is firmly seated on the table before allowing patients to use.

To remove the foot rest, squeeze the latch release hand grips until the latches disengage from the notches and slide it from the table.

SHOULDER REST (FIGURE 2-8) - The shoulder rest is equipped with the same kind of handles and latch releases as the foot rest and attaches to the table in the same way. The shoulder rest is ordinarily attached at the head end. To attach the shoulder rest to the table:

1. Hold the shoulder rest by the handles with the shoulder pads toward the table.

2. Squeeze both latch release hand grips against the handles and slide the shoulder rest onto the table top from the head end.

3. Position the shoulder rest over the desired notch pairs in the table top edges and release the hand grips. If an adjustment is needed for the latches to engage the desired notches, slide the shoulder rest in the appropriate direction until the latches engage.

4. The shoulder pads are independently adjustable. Adjust them by loosening the knurled adjusting knobs and setting them to the desired position. To remove the shoulder rest, squeeze the latch release hand grips until the latches disengage from the notches and slide it from the table.

2.7 SYSTEM ACCESSORIES (continued)

PATIENT HAND GRIPS (FIGURE 2-9) - The two (2) hand grips can be independently clamped at any location along the length of the table top. To attach the hand grips, press the release latch and place the hand grip in the released position. Turn the lock knob fully counterclockwise. Slide the hand grip clamp onto the edge of the table top. Position it at the desired location and place the handle in the lock position. Secure the hand grip to the table top by turning the lock knob clockwise.

Repeat above steps to install the remaining hand grip. Once they are attached, the position of the hand grips can be adjusted by loosening their clamps and sliding them to the new location.

WARNING

FOR PATIENT SAFETY, ALWAYS BE SURE THAT THE HAND GRIPS ARE FIRMLY CLAMPED TO THE TABLE TOP.

To remove hand grips, complete the above procedure in reverse.

COMPRESSION BAND (FIGURE 2-10) - The compression band consists of two (2) parts; the back assembly and the ratchet assembly. The back assembly secures one end of the compression band. The ratchet assembly is used to tighten the band after it is positioned over the patient and secured to the back assembly. The compression band is stored on the ratchet assembly when not in use.

Both assemblies are attached to the table by means of a clamping arrangement that is functionally identical to those used on other accessories. To attach and use the compression band:

1. Slide the back assembly onto the rear edge of the top from the foot end of the table.

2. Position the back assembly at the desired location.

3. Slide the ratchet assembly along the table top front edge until it is directly opposite the back assembly and secure in position by turning the two (2) knurled tightening knobs clockwise.

4. Grasp the compression belt by the end and stretch it over the patient. The free end of the belt is fitted with a metal rod having grooves at the ends. The compression belt is secured by engaging these grooves with the hooks on each side of the back assembly.

2.7 SYSTEM ACCESSORIES (continued)

5. Tighten the compression belt by pulling on the compression knob while turning it until the desired compression is achieved.

To remove the compression belt, release the tension by pushing in on the compression knob. Release the compression belt from the back assembly, and turn the compression knob to wind it back to the rachet assembly.

It is recommended that both compression belts be removed from the table when they are not in use.

UROLOGICAL KNEE CRUTCHES (FIGURE 2-11) - Both knee crutches can be independently positioned.

The appropriate knee crutch must be installed on the correct side of the table.

To attach the urological knee crutches:

1. Open the clamp as far as it will go by turning the knurled clamping knob counterclockwise while holding the base.

2. Slide each knee crutch clamp onto the edge of the table top with the clamping knob toward the foot end.

3. Position it at the desired location and tighten it by turning the clamping knob clockwise.

4. Repeat the above steps to install the remaining knee crutch.

Knee crutch adjustment is accomplished by the use of both the clamping and adjustment knobs. Loosening the clamping knob allows the entire knee crutch assembly to slide along the length of the table top. Loosening the adjustment knob allows the crutch to slide and rotate on its support shaft. The knee crutch adjustment consists of sliding and rotating each to the desired position and re-tightening the clamping and adjusting knobs.

To remove the knee crutches, complete the above procedure in reverse.

It is recommended that the knee crutches be removed from the table top when they are not in use.

2.7 SYSTEM ACCESSORIES (continued)

HEAD HOLDER (FIGURE 2-12) - attaches to the table top by means of two (2) lever actuated vacuum suction cups. To attach and use the head holder:

1. Position the head holder at the desired location with the actuating levers together.

2. Activate the vacuum cups by spreading the actuating levers apart.

3. Open the clamp by turning the adjusting knob counterclockwise.

4. Position the patient's head in the clamp and tighten the adjusting knob, as necessary.

WARNING

FOR PATIENT SAFETY AND COMFORT, ASSURE HEAD HOLDER IS NOT APPLIED TOO TIGHTLY.

LATERAL CASSETTE HOLDER (FIGURE 2-13) - This accessory does not attach to the table. The patient's weight on the base holds it in place. It can accommodate any cassette size up to 14" X 17" (35 cm X 42 cm).

PATIENT FOOTSTEP (FIGURE 2-14) - The retractable patient footstep is located at the head end of the table. Simply grasp it and pull it all the way out.

NOTE

The table cannot be tilted with the footstep pulled out.

2.7 SYSTEM ACCESSORIES (continued)

MOBILE GRID/CASSETTE HOLDER (FIGURE 2-15) - accommodates film cassettes up to 17 inches in size by inserting them in a slot formed by two (2) vertically adjustable parallel bars. These parallel bars are locked in the desired vertical position by a knob located on the right side of the top parallel bar. An additional slot in front of the film cassette slot is provided for the placement of a stationary grid.

The mobile stand can be moved to the desired position by standing behind the stand and placing a foot against its base. Then, grasp the top of the stand, tilt it backwards onto its wheels, and move it to the desired position.

The grid/cassette holder is counterbalanced and can be moved vertically to the desired position by loosening the knob on the back of the lower parallel bar, sliding the grid/cassette holder vertically, and locking it in place by tightening the knob.

Two (2) screwdriver adjustments are provided on the base to raise the back, taking the weight off of the wheels. Turning the screws clockwise raises the base. Turning them counterclockwise lowers the base.

MCT-II SIZE-SENSING TRAY (FIGURE 2-16) - This tray is used in conjunction with the collimator to focus the x-ray beam on the cassette and to minimize stray radiation.

The size-sensing tray is located in the grid chamber tray immediately under the table top.

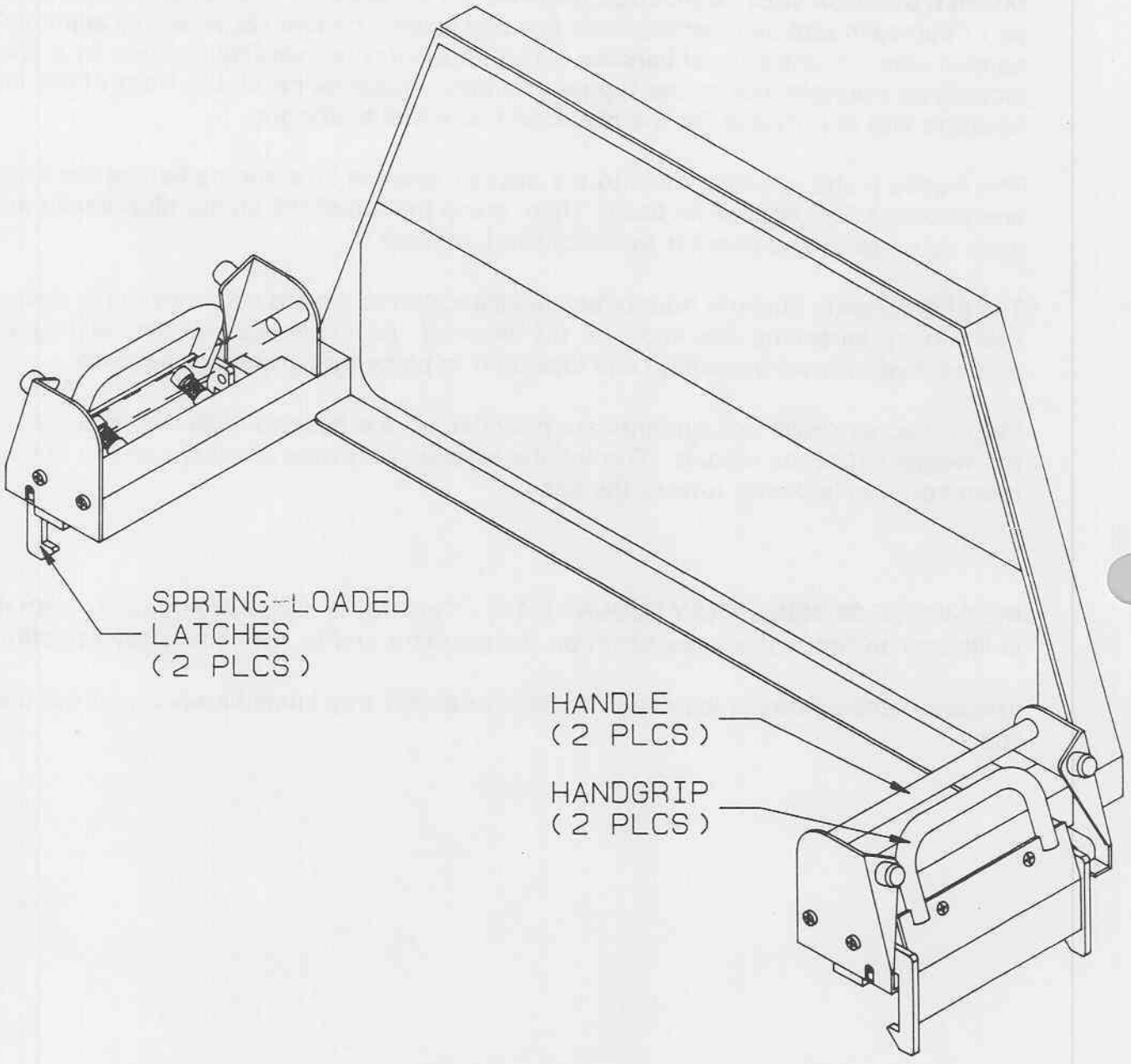


FIGURE 2-7 FOOT REST

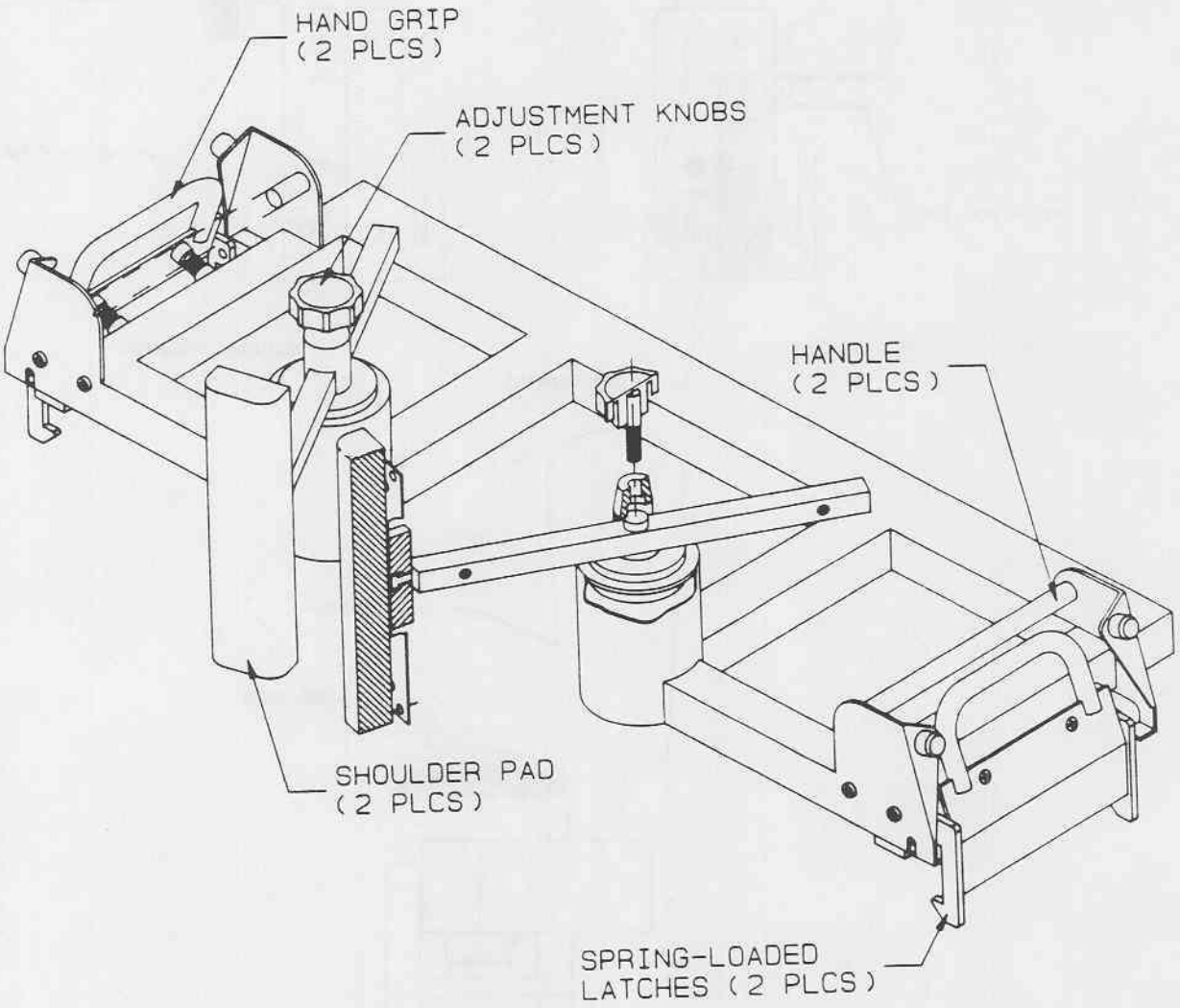


FIGURE 2-8 SHOULDER REST

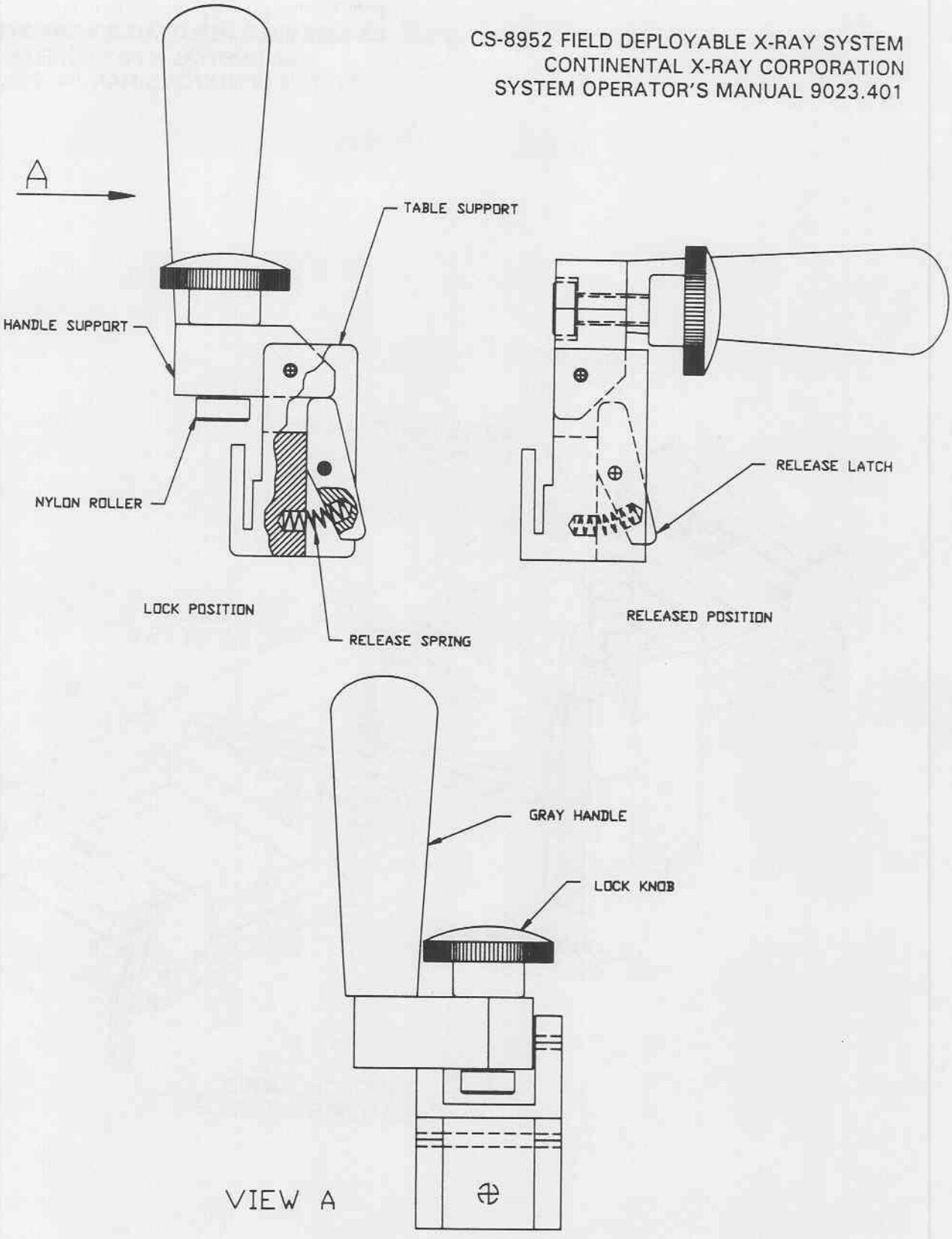


FIGURE 2-9 PATIENT HAND GRIPS

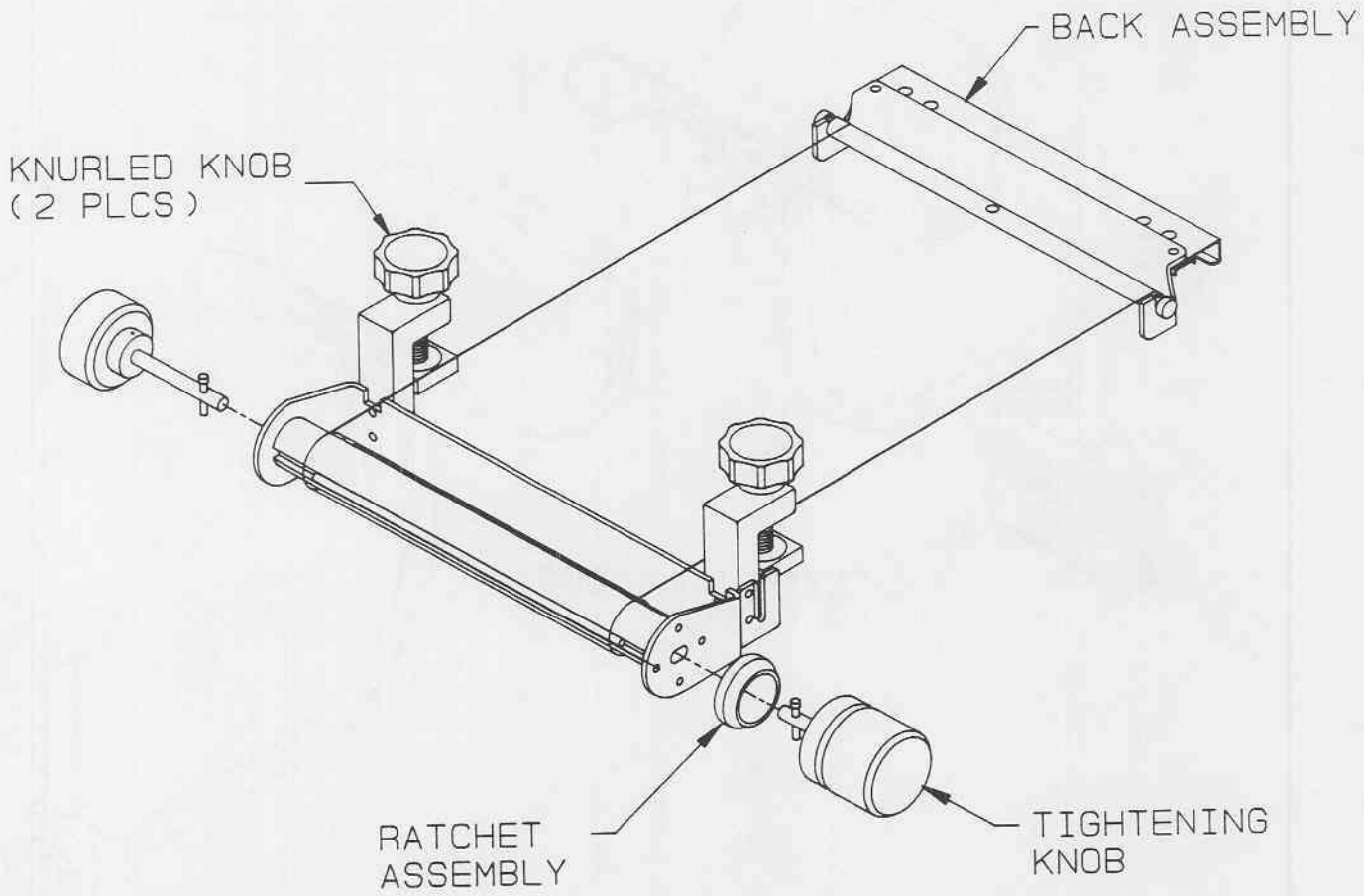


FIGURE 2-10 COMPRESSION BAND

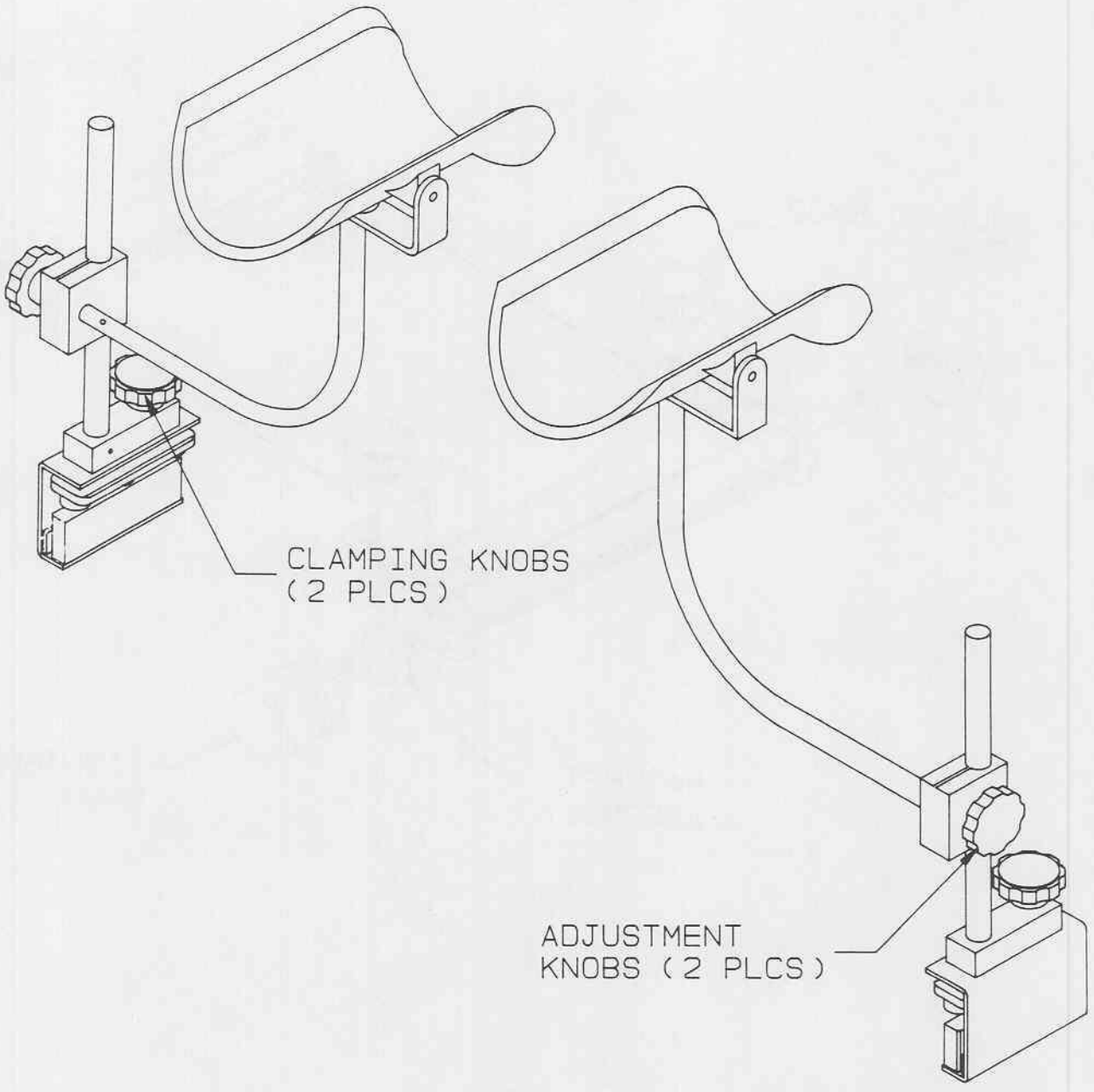


FIGURE 2-11 UROLOGICAL KNEE CRUTCHES

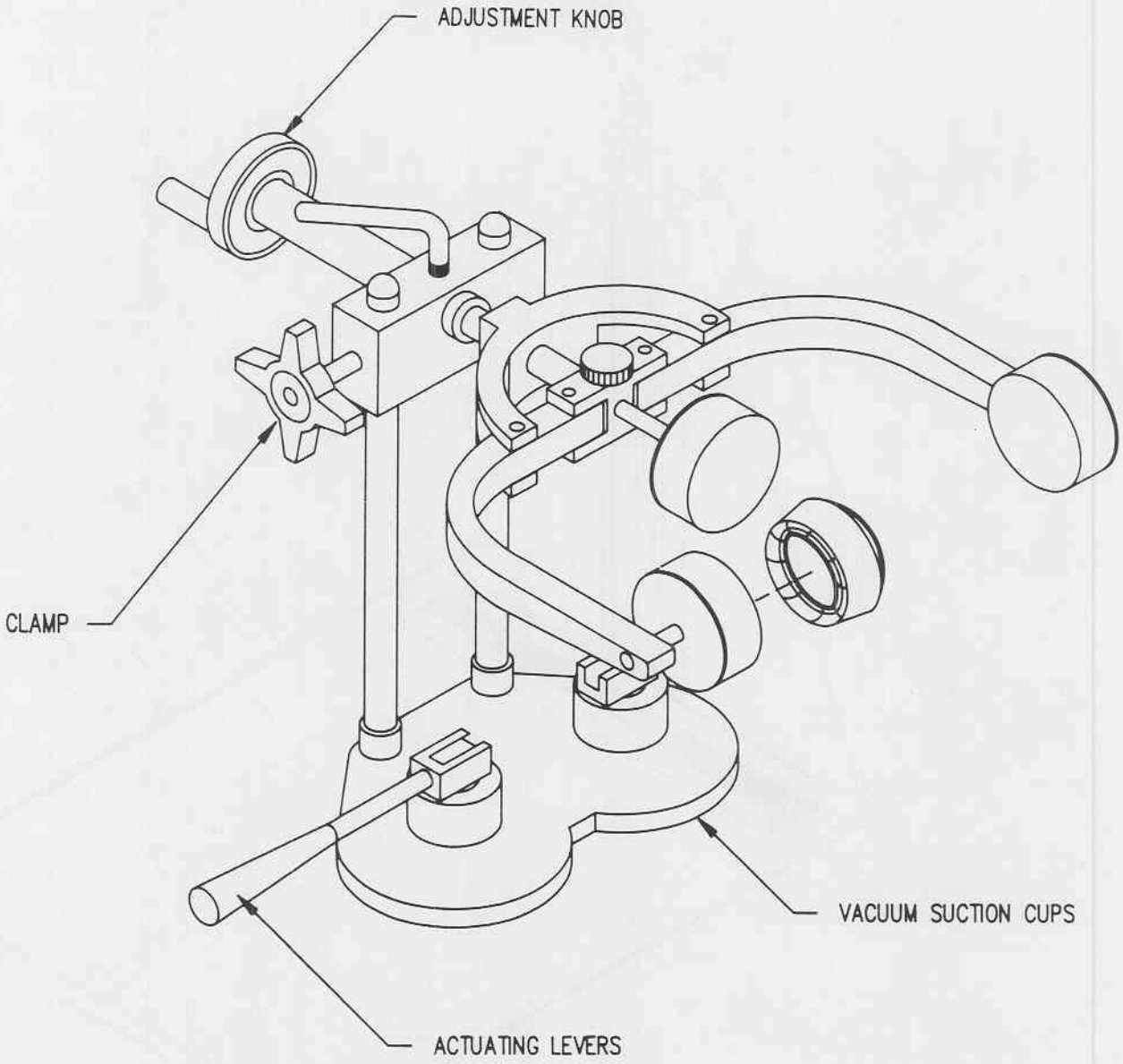


FIGURE 2-12 HEAD HOLDER

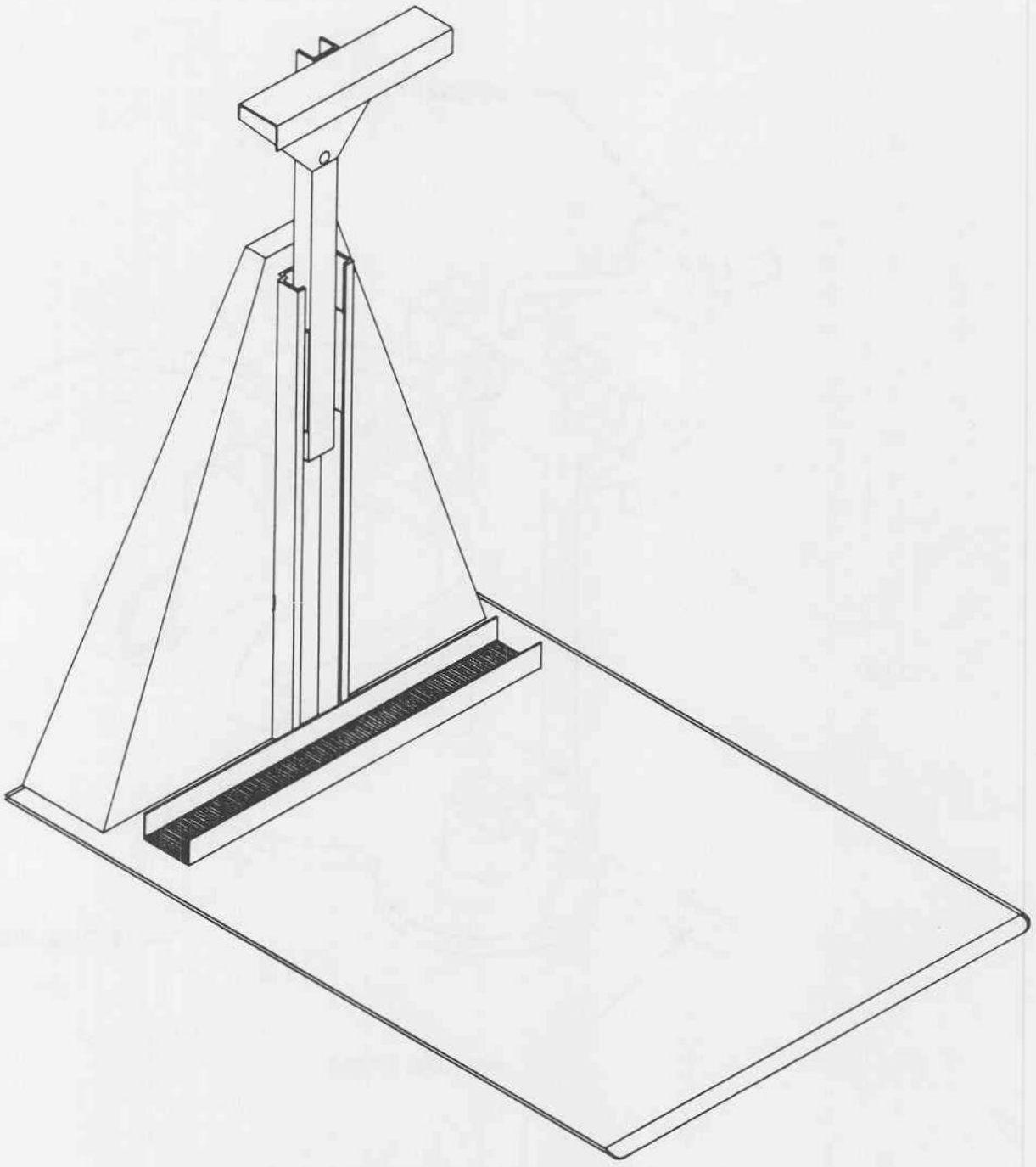


FIGURE 2-13 LATERAL CASSETTE HOLDER

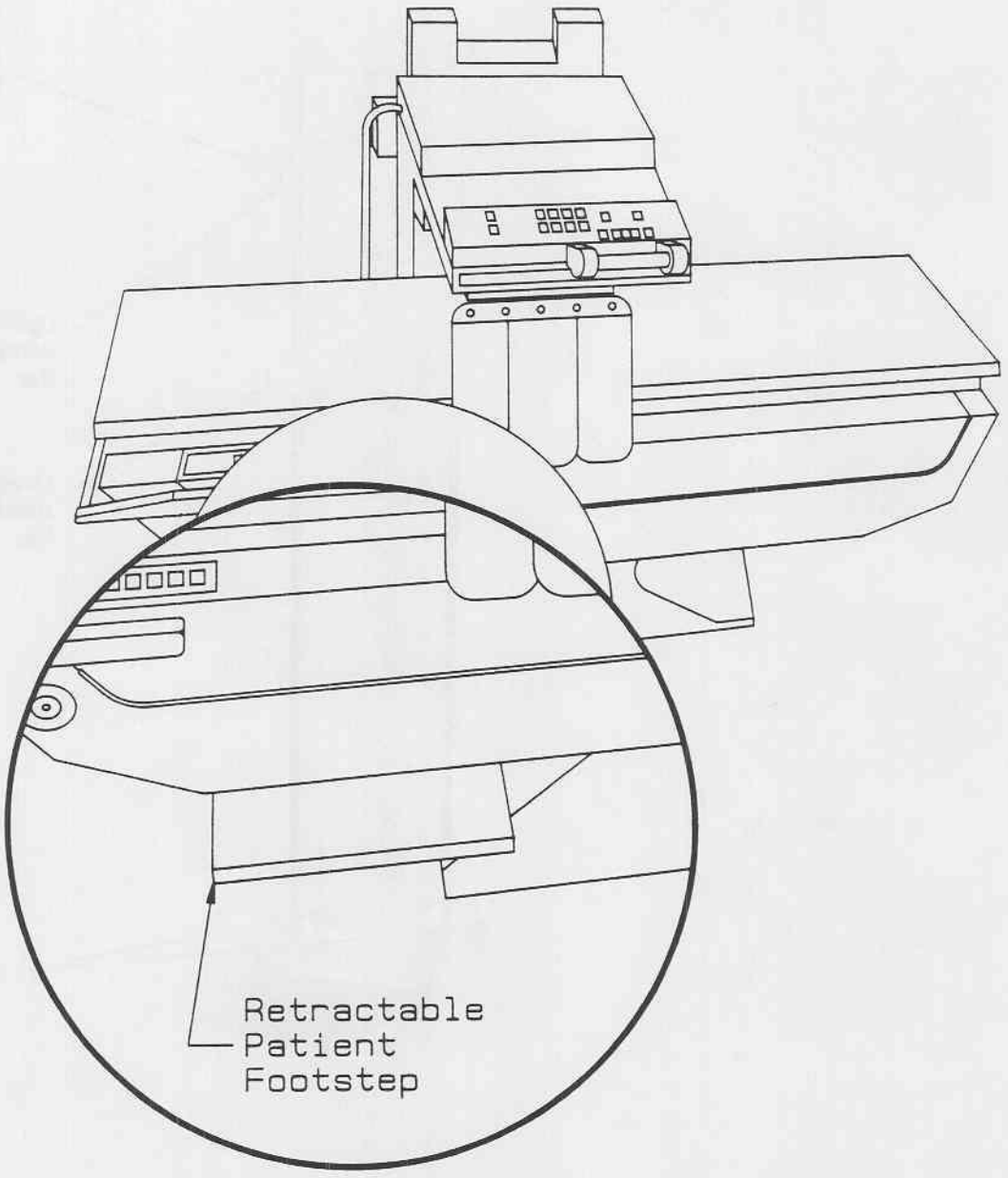


FIGURE 2-14 PATIENT FOOTSTEP

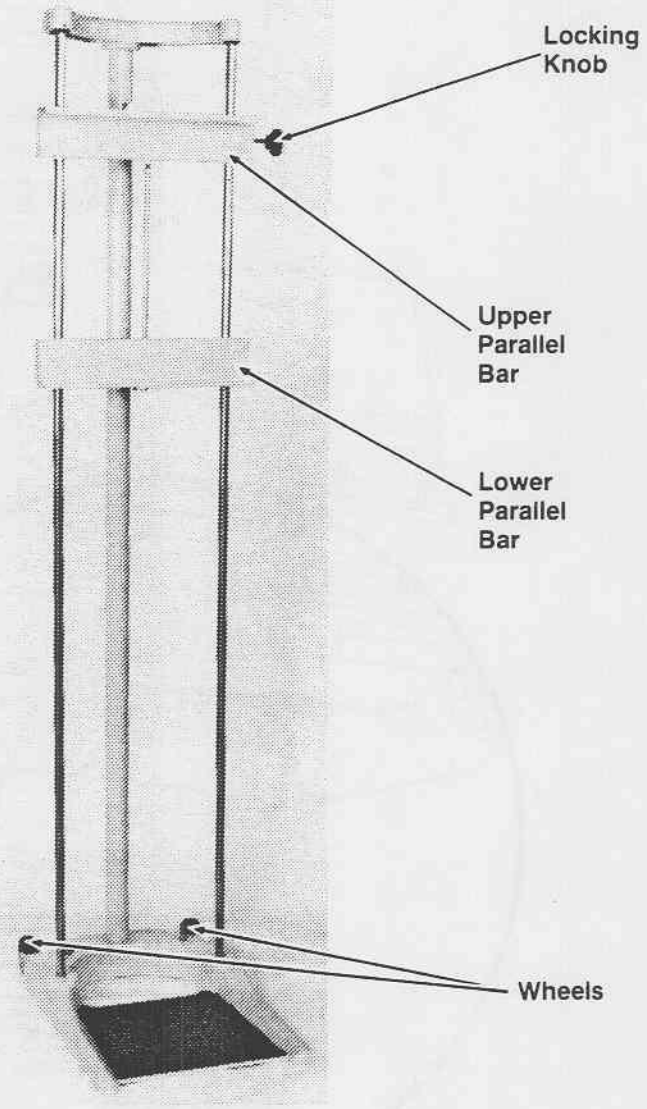


FIGURE 2-15 MOBILE GRID/CASSETTE/HOLDER

SECTION 3 - DAILY PRE-OPERATIONAL SYSTEM CHECK

3.1 INTRODUCTION

This section consists of a system check procedure that should be performed before examining the first patient of the day. Refer to FIGURES 2-1, 2-2, 2-4, and 2-5, as needed. The operational tests in this section are needed to ensure patient safety and proper system operation.

3.2 DAILY PRE-OPERATIONAL SYSTEM CHECK

Apply power to the system by pressing the MAINS push button on the generator front panel. Observe the line set meter. **The pointer should be positioned directly over the center reference mark.**

If it is not, use the fine and coarse line adjust controls to center it.

3.2.1 TABLE CHECK

When performing these tests, pay particular attention to smoothness and ease of operation. Make sure that there is no squeaking, or other unusual noises, or malfunction(s). Exercise all table motions as follows, beginning with the table top centered in the horizontal position (see FIGURE 2-4 for switch locations):

- Press and hold the longitudinal head switch (A) until the table top reaches its limit of travel. It should move approximately 30" from its centered position before it stops.

- Press and hold the longitudinal foot switch (B) until the table top reaches its limit of travel. It should move approximately 30" from its centered position before it stops.

- Press and hold the table center switch (C) until the table top stops. It should move to its center position, from either of the above mentioned longitudinal positions, before stopping.

- Press and hold the Trendelenburg tilt switch (D) until the table reaches its maximum tilt of 12° toward Trendelenburg and stops.

- Press and hold the vertical tilt switch (E). The table should stop at the horizontal position. Release the switch, and press and hold the switch again. The table should rotate to its maximum tilt of 88°, providing the table top is on "center" (in free standing or tactical shelter setup).

The spot film device must be at or near the foot end of the table if in the tactical shelter configuration.

3.2.1 TABLE CHECK (continued)

- Press and hold the Trendelenburg tilt switch until the table stops at horizontal. Release the switch.

WARNING

A FAULTY LOCK CAN CAUSE SERIOUS INJURY. DO NOT USE A SYSTEM WITH MALFUNCTIONING LOCKS.

On the spot film device, disengage the carriage (CARR) locks and the compression (COMP) locks and move the spot film device in all directions. It should take a minimum of twenty pounds force to move the spot film device in any direction.

3.2.2 TUBESTAND CHECK

Verify that the tubestand is energized by operating the locks and moving it through its various motions. Check the collimator to ensure that all lamps will light.

3.2.3 SPOT FILM DEVICE CHECK

Observe the spot film device for the presence of power. All push buttons should be lit. Cycle the cassette carriage by pressing the PARK/LOAD switch. The carriage should alternate between its park and load positions.

3.2.4 WARM-UP PROCEDURE

WARNING

IT IS NECESSARY TO MAKE EXPOSURES IN THE STEPS THAT FOLLOW. TAKE ALL PRECAUTIONS NECESSARY TO PROTECT PERSONNEL AGAINST UNNECESSARY RADIATION.

3.2 DAILY PRE-OPERATIONAL SYSTEM CHECK (continued)

3.2.4 WARM-UP PROCEDURE (continued)

NOTE:

Perform the "warm-up" procedure no more than one hour before the first case of the day, or if the system has been idle for one hour or longer.

This will protect the x-ray tube from potentially damaging high exposures on a cold target, due to thermal shock.

Thermal shock can cause a target to fracture, or in extreme cases, the target may break apart causing damage to the insert and/or tube housing.

Warming up increases the life of the x-ray tube.

Follow this procedure on both the over-table and the under-table x-ray tubes.

Turn **MAINS** on. Close the collimator blades.

1. Select [**200L**] mA station, **<70 kVp>**, and **<1/2 second>**, with no autotiming. Make three exposures at 20 second intervals.

2. Raise to **<80 kVp>**. Make three exposures at 20 second intervals.

3. Raise to **<90 kVp>**. Make three exposures at 20 second intervals.

4. Raise to **<100 kVp>**. Make three exposures at 20 second intervals.

The warm up procedure is complete.

SECTION 4 - OPERATING PROCEDURES

4.1 INTRODUCTION

This section identifies the procedures required for a radiographic, spot film and fluoroscopic exposure.

4.2 POWER APPLICATION

All components obtain power by activating the MAINS push button (switch C in FIGURE 2-1). The procedures discussed in this section require the operator to turn power on by using the MAINS switch. According to departmental protocol, turning power off will be accomplished at the completion of the x-ray procedure or end of shift as appropriate.

Check the line set voltage meter (AN in FIGURE 2-1) on the generator main control panel to assure proper power requirements. If adjustments are required, use the coarse line adjust (AH in FIGURE 2-1) or fine line adjust (AI in FIGURE 2-1) switch to correct them.

4.3 RADIOGRAPHIC PROCEDURES

Turn power on. Perform warm-up procedure described in paragraph 3.2.4.

4.3.1 RADIOGRAPHY WITHOUT AUTOTIMING

1. Select the desired radiographic mA control.

2. Measure the patient (affected body part) with calipers to determine appropriate kVp selection.

3. Set the desired radiographic kVp, using the major kVp and minor kVp knobs, in conjunction with the kVp meter on the main control panel.

4. Select the desired radiographic time, radiographic seconds.

5. Select "Autotiming" off at the main control panel.

6. Position patient on table.

7. Select appropriate size cassette and place it under the patient (affected body part).

4.3.1 RADIOGRAPHY WITHOUT AUTOTIMING (continued)

8. Measure source-to-image distance. Adjust collimator light field to equal the size of the cassette.

9. Press the PREPARE and EXPOSE push button simultaneously to execute x-ray exposure.

10. Remove cassette and develop film.

4.3.2 RADIOGRAPHY WITH AUTOTIMING

Proceed in the same way as for "Radiography without Autotiming", with these additions:

- Set "Autotiming" on.
- Set radiographic seconds on the timer for at least 50% longer than the anticipated exposure.
- The ion chamber in the table has three (3) fields. The operator must select the appropriate fields, depending on the body part to be radiographed. Press TABLE on the Autotimer section. This activates the ion chamber in the table.
- Select the appropriate density.

4.4 FLUOROSCOPIC PROCEDURE

1. Turn <**MAINS**> on.

2. Select <**200L SPOT**> mA station (H) on the main control panel.

Depressing the 200L SPOT push button selects the 200 mA station on the large focal spot of the under-table x-ray tube for spot film techniques.

This switch also disables **PREPARE** and **EXPOSE** (P and Q) so that their functions can only be activated from the spot film device control panel or the table footswitch.

3. Select the desired fluoro kVp (AE) on the main control panel.

4.4 FLUOROSCOPIC PROCEDURE (continued)

4. Select the desired fluoro mA (A) on the main control panel. Note that this selector switch has five positions, i.e., <A>, <B>, <C>, <D>, or <E>.

> **WARNING:**
>
> The <D> and <E> mA fluoro positions are for high-level fluoroscopy. To activate high-level fluoroscopy, <D> or <E> must be selected and the foot-switch must be depressed to the second stage. If <D> or <E> are selected, and the foot-switch is only depressed to the first stage, the <C> level of fluoroscopy will be obtained.
>
> Use of high level fluoroscopy will subject the patient to elevated radiation exposure entrance rates, and should only be used when a satisfactory fluoroscopic image cannot be obtained at lower levels.
>
> Use of high-level fluoroscopy is recommended for examinations of the abdominal and pelvic regions, and only for the time required to obtain necessary diagnostic information.

5. Select the desired fluoro time (B) on the main control panel.

This control indicates to the operator fluoroscopic exposure duration of up to five (5) minutes. After five minutes, a buzzer sounds as long as the exposure continues. Upon exposure release, the timer must be manually reset before subsequent fluoroscopic exposures are allowed.

6. Position patient on table.

7. Move the spot film device over the patient.

8. Press the **PARK/LOAD** push button (G8) to ensure that the spot film cassette is in its operating (PARK) position.

10. For fluoroscopy, press the footswitch or X-RAY push button (E) on the spot film device control panel.

The fluoro timer is activated only while fluoroscopy is in process.

11. Adjust the mirror assembly on the image intensifier to optimize viewing.

4.5 FLUOROSCOPY WITH SPOT FILM PROCEDURE

1. Turn <**MAINS**> on.

2. Select the 200L SPOT mA pushbutton (H in **FIGURE 2-1**) for all spot film and fluoroscopy work.

3. Select an appropriate radiographic kVp using the major kVp and minor kVp knobs (AF and AG).

4. Set the radiographic seconds to the desired exposure time. If autotiming is to be used, select radiographic seconds for a time at least 50% greater than the expected exposure time. This serves as a back-up exposure termination in the event of autotimer failure.

5. Set the fluoroscopic kVp to the desired level using the fluoroscopic kVp knob (AE).

6. Set the desired fluoroscopic mA on the fluoroscopic control section of the control panel (**FIGURE 2-1**). Selections A, B, and C are for low-level mA settings. Selections D and E are for high-level mA settings.

WARNING:

The <**D**> and <**E**> mA fluoro positions are for high-level fluoroscopy. To activate high-level fluoroscopy, <**D**> or <**E**> must be selected and the foot-switch must be depressed to the second stage. If <**D**> or <**E**> are selected, and the foot-switch is only depressed to the first stage, the <**C**> level of fluoroscopy will be obtained.

Use of high level fluoroscopy will subject the patient to elevated radiation exposure entrance rates, and should only be used when a satisfactory fluoroscopic image cannot be obtained at lower levels.

Use of high-level fluoroscopy is recommended for examinations of the abdominal and pelvic regions, and only for the time required to obtain necessary diagnostic information.

A, B, and C levels are obtained whenever either the **X-RAY** button on the spot film device or the footswitch is pressed.

When high level is activated, a repetitive beep will be heard from the x-ray control until high level is released.

4.5 FLUOROSCOPY WITH SPOT FILM PROCEDURE (continued)

7. Set the fluoro timer (B) up to 5 minutes. The fluoro timer indicates accumulated fluoroscopic exposure time since last reset.

At the end of the preset time, fluoro exposure will continue but a buzzer will sound until the exposure is released. Subsequent fluoroscopy is disallowed until the timer is reset.

8. If autotiming of spot films is desired, depress **AUTOTIMER ON/OFF** selecting autotimer on.

Select the spot film detector and any field. The spot film detector has only one field so which field is selected does not affect operation. Density selection is made from the density switch on the spot film device control panel (C).

> **NOTE:**
>
> If **AUTOTIMER RESET** illuminates at the end of a spot film exposure, it means the selected radiographic time was too short, and the timer rather than the autotimer terminated tne exposure. Increase either time or kVp to prevent recurrence.

9. Position patient on table.

10. Press **CARR** locks switch (A in **FIGURE 2-2**) on the spot film device to disengage the locks, if necessary, and move the spot film device into the locked in-beam position.

11. Load a cassette through the front panel slot.

12. Re-engage the locks by pressing **CARR** locks a second time.

13. Position the compression cone at spot film device, if desired. Position the mylographic stop if required.

14. Select the desired mode of the **SHTR AUTO** push button on the spot film device.

15. Press and hold the **PREPARE** push button on the spot film device.

16. Press the **X-RAY** push button or the footswitch.

The PREPARE push button and one of the X-RAY switches or the footswitch must be simultaneously pressed and held once for each exposure.

SECTION 5 - BIOLOGICAL EFFECTS OF RADIATION

5.1 GENERAL

The effects of x-radiation on living tissue are generally assumed to be almost entirely the result of ionization. The disruption of tissue molecules by recoiling particles, especially neutrons, is also a factor. The effect of continual exposure to small amounts of radiation can be very subtle, producing no apparent change in the health of the individual. However, genetic changes may occur causing mutations in later generations.

Just how much x-radiation can cause this kind of damage is the subject of disagreements between geneticists and physicians. It may be safely assumed that if the present Atomic Energy Commission (AEC) requirements are met, no appreciable genetic change will be observed. One of the covert effects is the destruction of blood producing tissue in bone marrow, causing symptoms of anemia and other blood cell damage.

The following shows the effects of acute radiation doses within a 24-hour period over the whole body:

0 - 5 R	No obvious injury.
5 R -25 R	First detectable blood change.
25 - 50 R	Blood changes - No serious injury.
50 - 100 R	Blood changes, some injury, no disability.
100 - 200 R	Injury, possible disability.
200 - 400 R	Injury and disability certain, possible death.
400 - 500 R	Fatal to 50%.
600 R or more	100% fatalities.

5.1 GENERAL (continued)

TIME AFTER EXPOSURE	MODERATE DOSE (100 - 300 R)	MEDIUM LETHAL DOSE (400 R)	LETHAL DOSE (600 R)
First Week	No definite symptoms	Nausea and vomiting after 1 - 2 hours. No definite symptoms	Nausea and vomiting after 1 - 2 hours. No definite symptoms. Diarrhea. Throat and mouth inflam-mation
Second Week			Fever, rapid loss of weight. Mortality 100%
Third Week		Beginning of loss of hair by the roots. Loss of appetite and uneasiness. Fever, throat and mouth inflammation.	
Fourth Week	Moderate weight loss. Recovery likely unless complications exist.	Diarrhea, nosebleeds, pale skin, weight loss rapid. 50% mortality rate.	

TABLE 5-1 RESULTS OF WHOLE BODY EXPOSURE TO X-RADIATION

5.1 GENERAL (continued)

DOSE RATE	PERIOD OF TIME AT DOSE RATE	EFFECT
500 R/Day	2 Days	Mortality close to 100%.
100 R/Day	Until death occurs	Mean survival time about 15 days. 100% mortality in 30 days.
60 R/Day	10 Days	Morbidity and mortality rate high with crippling injuries.
30 R/Day	10 Days	Disability moderate.
10 R/Day	365 Days	Some deaths.
3 R/Day	Few Months	No drop in efficiency.
0.5 R/Day	Many Months	No large scale drop in life span.

TABLE 5-2 ESTIMATED DOSES FOR VARYING DEGREES OF INJURY

Comparison of TABLES 5-1 and 5-2 indicates that it makes a difference how the dose is received. It is less harmful to receive numerous smaller dosages rather than a single large exposure of the same total.

BLOOD TESTS - A great deal of reliance had been placed on blood tests in the early days when other means of determining exposure rates were unreliable, unavailable, or unknown.

Roentgenologists may be able to determine that radiation damage has occurred in the blood with an exposure of 1 R, providing that a complete medical history of the patient is available. This includes blood test reports taken at least monthly over an extended period of time. Lacking this previous history, it is doubtful if the Roentgenologist can be certain damage has occurred with exposures less than 5 R.

Natural and Diagnostic Exposures

Cosmic Rays, Average	0.1 R/Year
Cosmic Rays, Denver, Colorado	0.5 R/Year
Routine Chest X-ray*	.01 to 0.5 R/Exposure
Routine Gastro-Intestinal X-ray*	1 R/Exposure
Fluoroscopic Examination*	2 to 10 R/Minute
Cinefluorography (X-ray Movie)*	25 R/Examination

* These exposures are to parts of the body only.

5.1 GENERAL (continued)

THE MAXIMUM PERMISSIBLE DOSE

About thirty days after Roentgen's announcement of his discovery of x-rays, in December 1895, Emil Grubb of Chicago reported radiation injury to himself in the form of dermatitis on his hands. The first attempts to establish Maximum Permissible Dose limits were based on the dose required to produce skin erythema.

In the last twenty years, emphasis has shifted to the genetic effects which are not thought to be subject to the repair process, and as a result, there can be no tolerance dose. The accumulative population dose from all radiation sources, including background, is the prime consideration rather than the individual dose, and a small number of radiation workers may be subjected to higher levels of radiation as long as the hazard of genetic effects to the total population are not considered to be increased.

In 1958, the International Committee on Radiation Protection (ICRP) recommended a maximum accumulation whole body dose for occupational personnel of 5 (N-18) rems where N is the body age of the individual. This amounts to an average dose of 5 rems per year past the age of eighteen (18). It was further specified that no more than 3 rems should be accumulated in any 13 week period. Medical exposures are excluded.

It was also recommended that non-occupational people or persons outside a controlled area should receive no more than 0.5 rem per year from external radiations. Federal regulations (Title 10, Section 20) are more restrictive, requiring a Maximum Permissible Dose of 1-1/4 rems per calendar year quarter for most radiation work. The U.S. Atomic Energy Commission is currently permitting the various states to set up their own regulatory agencies providing certain minimum requirements are met.

On the subject of Maximum Permissible Dose, a motto worthy of consideration is:

"Think of minimum possible exposure rather than maximum permissible dose".

Shielding of a radiographic room is specified in appropriate publications (NCRP REPORT #34) and is determined with the aid of a qualified expert.

SECTION 6 - RADIOGRAPHIC TECHNIQUES FOR THE AVERAGE LABORATORY

6.1 INTRODUCTION

The instructions in this section can be used as a guideline. They will provide a starting point if it is necessary to devise an appropriate technique or investigate a radiographic problem.

This technique is based on the variable voltage or thickness of body part, where kVp is adjusted depending on the thickness of the body part and the mAs remains constant. It provides a means of converting the tabulated data to various film/screen speeds other than high speed calcium tungstate. It enables operators to develop a technique for a given body part when the factors for another part are known.

Before proceeding, make sure the x-ray timer is accurate, the generator is properly calibrated, and the kVp and mA are correct on both x-ray tubes and on all mA stations. An aluminum ladder film should be made using the same kVp and mAs on each tube and mA selection and the density of each corresponding step should be the same. Make sure all accessories are operating correctly and darkroom solutions are fresh. All techniques discussed apply to single phase x-ray generators.

6.2 BASIC TECHNIQUES - The accompanying Technique Chart (TABLE 6-1) provides a beginning point for developing a technique chart for a particular x-ray system under specific circumstances. It is not possible to anticipate all variations due to line drop under load, x-ray tube condition, etc. These will have to be accounted for by making a Technique Chart under actual operating conditions. The supplied chart will, however, provide a reasonable approximation of the required factors.

6.3 USING THE CHART - The Technique Chart is organized by study type (body part). Locate the desired heading for the study to be performed. If the specific study is not listed, use the study that covers the same anatomical area and tissue type. For example, if the desired study is the kidneys, use ABDOMEN. Measure the patient and locate the thickness in the CM row. Find the correct position and read the desired kVp directly below the patient's thickness. Set the mA station and time as specified for that position.

MXR-350 X-RAY TECHNIQUE CHART

CERVICAL SPINE

Position: ALL	Distance: 40"	Grid: Yes	mA: 100S	Time: 1/5	mAs: 20										
CM	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
kVp	52	55	58	61	64	67	70	72	75	78	81	83	85	88	90

THORACIC SPINE

Position: AP, OBL	Distance: 40"	Grid: Yes	mA: 300L	Time: 1/4	mAs: 75															
CM	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
kVp	54	56	59	61	63	65	68	72	75	77	80	82	85	87	90	93	96	100	104	107	110
Position: LAT	Distance: 40"	Grid: Yes	mA: 300L	Time: 1/4	mAs: 75																
kVp			54	56	58	60	62	65	67	69	71	73	74	76	78	80	82	84	86	88	90

LUMBAR SPINE

Position: AP, OBL	Distance: 40"	Grid: Yes	mA: 200L	Time: 1	mAs: 200															
CM	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
kVp	55	58	61	64	67	69	72	76	80	83	86	89	93	97	100	103	105	108	111	115	118
Position: LAT	Distance: 40"	Grid: Yes	mA: 200L	Time: 1	mAs: 200																
kVp	63	65	68	71	72	74	76	78	80	81	83	85	87	88	90	93	97	100	102	105	108

HIPS & PELVIS

Position: AP, OBL, Frog Leg	Distance: 40"	Grid: Yes	mA: 200L	Time: 1/4	mAs: 50															
CM	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
kVp	62	65	69	73	76	80	83	86													
Position: AP, OBL, Frog Leg	Distance: 40"	Grid: Yes	mA: 200L	Time: 1	mAs: 200																
kVp									63	66	69	72	75	79	82	85	88	91	94	97	100
Position: LAT	Distance: 40 "	Grid: Yes	mA: 200L	Time: 1/2	mAs: 100																
kVp			59	60	62	64	66	68	70	72	74	75	77	78	80	82	83	85	86	88	

EXTREMITIES

Position: ALL	Distance: 40"	Grid: No	mA: 100S	Time: 1/10	mAs: 10																
CM	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
kVp		38	40	43	45	47	49	51	53	56	58	60									
Position: ALL	Distance: 40"	Grid: No	mA: 100S	Time: 1/5	mAs: 20																
kVp													49	51	53	55	57	59	60	62	64
Position : ALL	Distance: 40"	Grid: Yes	mA: 100S	Time: 1/2	mAs: 50																
kVp			41	43	45	47	49	51	53	55	57	59	61	63	65	68	70	72	74		

NOTES:
1. For patients under the age of 12 or over the age of 60, deduct 2 cm from measured thickness.
2. For highly muscular patients, add 2 cm to measured thickness.
3. This chart is based on Standard High Speed calcium tungstate intensifying screens. For other speed systems, adjust techniques as follows:

	mAs Adjustment	OR	kVp Adjustment
Par Speed -	Multiply mAs by 1.5	OR	Multiply kVp by 1.06
High Plus -	Multiply mAs by 0.8	OR	Multiply kVp by 0.96
Rare Earth 200 -	Multiply mAs by 0.5	OR	Multiply kVp by 0.83
Rare Earth 400 -	Multiply mAs by 0.25	OR	Multiply kVp by 0.71
Rare Earth 800 -	Multiply mAs by 0.125	OR	Multiply kVp by 0.58

SKULL

Position: PA, Stenvers, Rhese	Distance: 40"	Grid: Yes	mA: 100S	Time: 1/4	mAs: 25																
CM	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
kVp	45	47	49	51	53	56	60	64	69	74	78	82	85	89	93	98					
Position: PA, Stenvers, Rhese	Distance: 40"	Grid: Yes	mA: 100S	Time: 1/2	mAs: 50																
kVp														75	78	82	85	89	93	98	102
Position: LAT, Sinus, Hickey	Distance: 40"	Grid: Yes	mA: 100S	Time: 1/4	mAs: 25																
kVp	45	47	49	51	53	56	60	64	67	71	74	78	81	83	86	88	91	94	96	98	100
Position: Waters, Caldwell, Law	Distance: 40"	Grid: Yes	mA: 100S	Time: 1/2	mAs: 50																
kVp	47	49	51	53	56	59	62	65	69	72	74	76	78	81	83	85	87	89	92	94	97

TABLE 6-1 BASIC TECHNIQUES

SHOULDER

Position: AP	Distance: 40"	Grid: Yes	mA: 200L	Time: 1/6	mAs: 33																
CM	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
kVp	46	48	50	52	54	56	58	60	62	64	67	70	72	74	76	78	81	83	85		
Position: Axial	Distance: 40"	Grid: Yes	mA: 200L	Time: 1/10	mAs: 20																
kVp	43	45	46	47	49	51	54	57	59	61	63	65	67	70	72	74	76	78	80	82	83
Position: LAT	Distance: 40"	Grid: Yes	mA: 200L	Time: 1/5	mAs: 40																
kVp	47	49	51	53	55	57	60	62	65	67	69	72	74	77	79	81	83	85	87	89	91

CHEST*

Position: PA	Distance: 72"	Grid: No*	mA: 300L	Time: 1/60	mAs: 5																
CM	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
kVp	73	75	77	80	82	84	85	87	89	92	95	98	100	103	105	107	110	112	115	119	124
Position: LAT	Distance: 72"	Grid: No	mA: 200L	Time: 1/30	mAs: 6.67																
kVp	73	75	78	80	82	84	85	87	90	93	97	99	102	105	107	109	111	114	118	122	128

ABDOMEN - (No Barium)

Position: ALL	Distance: 40"	Grid: Yes	mA: 300L	Time: 1/20	mAs: 15																
CM	08	09	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34	36	38	40
kVp	59	62	65	69	73	77	81														
									mA: 300L		Time: 3/20			mAs: 40							
kVp							61	65	70	78	85										
									mA: 300L		Time: 2/5			mAs: 120							
kVp											66	74	80	85	95						
									mA: 300L		Time: 1			mAs: 300							
kVp													70	76	82	87	93				
									mA: 200L		Time: 2-1/2			mAs: 500							
kVp																77	81	85	90	96	

* For Grid, add 3 cm to actual chest measurement.

ABDOMEN - BARIUM

Position: ALL	Distance: 40"	Grid: Yes	mA: 200L	Time: 1/60	mAs: 3.3																
CM	08	09	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34	36	38	40
kVp	89	93	98	103	107	112	119	126	134												
Position: ALL	Distance: 40"	Grid: Yes	mA: 200L	Time: 1/20	mAs: 10																
kVp								98	105	115	127	139									
Position: ALL	Distance: 40"	Grid: Yes	mA: 200L	Time: 1/5	mAs: 40																
kVp											87	96	104	110	122	135					
Position: ALL	Distance: 40"	Grid: Yes	mA: 200L	Time: 1	mAs: 200																
kVp															82	89	97	102	108	113	122

Note: For spot films, deduct 2 cm from measured thickness of ABDOMEN - BARIUM Technique.
Autotiming (AEC) is strongly recommended for spot film work.

TABLE 6-1 BASIC TECHNIQUES (continued)

6.4 SUPPLEMENTAL INFORMATION

The technique for general radiography is not uniform from one x-ray department to another or even from machine to machine. As a result, any technique may have to be modified. It is necessary to know the efficiency of the equipment as well as the condition and types of screens, film, and processing solutions. Determine the techniques that produce satisfactory films for the body parts listed in TABLE 6-1 and calculate the other techniques.

Very young or old people may require 4 to 8 kVp less than normal, except for a small child's chest.

6.4 SUPPLEMENTAL INFORMATION (continued)

Muscular individuals may require 4 to 5 kVp more than average, while emaciated persons require 4 to 5 kVp less.

If pathology is present, the tissue may be more or less opaque than average. Some knowledge of existing pathology may be necessary in order to make the needed allowances.

Refer to TABLES 6-2 and 6-3 for various conversion factors and basic rules of use.

GRID CONVERSION FACTORS	
KVP CONSTANT	
GRID RATIO	MAS
5:1	2 X Non-Grid mAs
6:1	3 X Non-Grid mAs
8:1	4 X Non-Grid mAs
10:1	5 X Non-Grid mAs
12:1	5 X Non-Grid mAs
16:1	6 X Non-Grid mAs
MAS CONSTANT	
GRID RATIO	INCREASE NON-GRID KVP
5:1	Add 10 - 12 kVp
6:1	Add 10 - 15 kVp
8:1	Add 12 - 18 kVp
12:1	Add 15 - 21 kVp
16:1	Add 18 - 24 kVp

TABLE 6-2 GRID CONVERSION FACTORS

6.4 SUPPLEMENTAL INFORMATION (continued)

USEFUL KVP RANGE - It is desirable to keep the kVp between certain limits in order to image various parts of the body.

REGION	KVP RANGE
Mastoids & Jaw	55 - 75
Skull	55 - 90
Sinuses	55 - 75
Pelvis & Spine	55 - 90
Chest	60 - 130
Abdomen	55 - 90
Extremities	40 - 80

TABLE 6-3 APPROXIMATE ANATOMICAL KVP RANGES

SECTION 7 - OPERATOR MAINTENANCE

7.1 INTRODUCTION

Operators can make a valuable contribution to equipment maintenance by making frequent visual inspections of the equipment, associated hardware, and wiring. They can often identify potential malfunctions before they cause an equipment failure that could be dangerous to both patients and operators.

WARNING

ALWAYS CONTACT A QUALIFIED MEDICAL EQUIPMENT REPAIRER TO CORRECT PROBLEMS THAT MAY BE FOUND DURING THE COURSE OF AN INSPECTION.

CAUTION

THE X-RAY SYSTEM CONTAINS NO OPERATOR SERVICEABLE PARTS. REFER ALL SERVICING TO A QUALIFIED BIOMEDICAL MAINTENANCE TECHNICIAN.

7.2 SYSTEM INSPECTION

Test all front panels controls and the meters for correct operation and to ensure that they light properly.

Check all nuts and bolts, screws, rivets, and other fasteners to ensure that they are tight. Also be sure that all fasteners are present and in good condition.

Inspect all electrical cables, cords, connectors, and fittings for tightness. Check for breaks in the insulation, abrasions, and other damage to cables and connectors. Pay particular attention to the high voltage cables and areas where electrical cable enters cable housings for they are subject to stress from mechanical motions.

Examine all exterior painted or plated surfaces for evidence of deterioration, such as scratches, chipping and corrosion. Make sure that all name plates and warning labels are present, legible and securely mounted.

Perform the Daily Pre-Operational System Check, Section 3.

SECTION 8 - SYSTEM CLEANING INSTRUCTIONS

WARNING

ALWAYS TURN POWER OFF BEFORE BEGINNING ANY CLEANING PROCEDURE.

8.1 GENERAL

Spillage of liquid on any component can cause a malfunction, particularly if it finds its way into the interior. This is especially so with liquids that leave a solid residue after they dry. It is important to promptly remove spills with a soft cloth dampened in warm water.

Regular cleaning of almost all components can be accomplished with a soft cloth, warm water, and a mild detergent.

8.2 IMAGE INTENSIFIER CLEANING

The output lens and the viewing mirror on the image intensifier are susceptible to dust accumulation and smudging due to handling. It is recommended that the operator have access to some type of lens tissue and lens cleaning solution to clean the mirror and outer lens.

Any material that could cause scratching or any other type of permanent marking should be avoided.

8.3 TUBESTAND

The exterior of the tubestand should be wiped down with a mild soapy solution and clean, dry cloths to rid it of dust and foreign materials. Particular attention should be paid to the steel transport rails.

SECTION 9 - STORAGE INFORMATION

9.1 GENERAL

The system can be indefinitely stored indoors or outdoors, if it is protected from rain, at temperatures not exceeding 122° F (50° C) relative humidity no greater than 100%. If these limits are exceeded for more than 24 hours, the system must be installed and allowed to acclimate for at least 24 hours before power is applied.

9.2 STORAGE INFORMATION OF SPOT FILM DEVICE

The spot film device can be stored for as long as eight (8) years in environments whose temperature and relative humidity do not exceed 122° F (50° C) and 100%. Exceeding these limits may cause deterioration of the cassette carriage drive belts.

In addition, tension on the drive belts may distort them when they are unused for an extended period of time. It is recommended that the tension be relaxed on all belts if the spot film device is to be stored for more than six months. Do this by loosening both tension idler pulleys inside the spot film device.

Prepare the spot film device for storage by repacking it in its original shipping material whenever possible. If the original packing material is not available, use a heavy-duty corrugated cardboard carton or a wooden crate whose inside dimensions exceed those of the spot film device by at least 15% in all directions.

Before placing the spot film device in the container, cushion the bottom with no less than 2" (50mm) of foam padding, or other similar material. After centering the unit in the container, fill all empty spaces, including the top, with enough padding to prevent shifting. Finally, use a high quality tape to seal the container or nail it shut, as appropriate. Masking tape is NOT recommended with cardboard cartons because its adhesive often fails with age.

Avoid stacking heavy items on top of the container during storage to make sure the equipment is protected against damage.

9.3 STORAGE INFORMATION OF IMAGE INTENSIFIER

When the image intensifier system is not in use for an extended period of time or when it is being stored, it becomes necessary to "season" the intensifier tube. "Seasoning" is done by applying electrical current to the tube for a 24 hour period.

If the tube has been installed and has been idle for an extended period of time, i.e., 4 to 6 months, power can be applied to it through the spot film device. Check to make sure the power supply cord is connected to the spot film device control panel and then turn the power on and let it run for 24 hours before operating.

If the tube is being stored, it is recommended that the tube be "seasoned" every 6 months. Before installation, power can be applied by using the auxiliary power cord supplied with the system.

The auxiliary cord is equipped with a bulkhead receptacle which will accept the bulkhead plug on the power supply cord. Once the auxiliary cord and the power supply cord are connected, the auxiliary cord can be plugged into any 120V line. Allow current to run through the tube filament for 24 hours.

The maximum allowable storage period without seasoning is five (5) years. After extended storage (longer than one year), the image tube should be "seasoned" for a minimum of seventy-two (72) hours.